

PRS-ELS-87-041

3 JULY 1987



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# ***JPRS Report***

# **Science & Technology**

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***Europe & Latin America***

23 JULY 1987

SCIENCE & TECHNOLOGY  
EUROPE & LATIN AMERICA

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FINNISH SPACE PROJECTS, COMPANIES, CONTRACTS

Helsinki HELSINGIN SANOMAT in Finnish 6 Jun 87 p B 5

[Article by Juhani Aromaki: "Finland Reaches into Space"]

[Text] Dr Risto Pellinen, the chief of the aeronomics office at the Meteorological Institute, waxes enthusiastic as he speaks of traveling to Mars. The tale intensifies and takes the listener with it, suddenly beginning to sound like an excerpt from science fiction.

"But everyday work among these subjects is anything but fantasy; it is continuous struggle in the jungles of new concepts, clearing new pathways and dipping into the well of new ideas. We are taking part in a space research project that appears not to have any boundaries," he sighs.

Finland has been caught up in international space research so rapidly that the space research program for 1987-1992, published Friday, was already out of date in many places at publication time, according to Pellinen.

The team at the Meteorological Institute is working on four Soviet projects. Three of them are for studying the planet Mars and its moons, on the atmosphere of the earth and Aurora Borealis. In addition to the Meteorological Institute the state's Center for Technological Research (VTT) is taking part in the research. In addition to Finns, Swedes, Germans, French and the Austrians, among others, are taking part in these programs.

Two probes weighing three tons each are being sent toward Mars on the 7th and the 12th of July, 1988 with Phobos space crafts from Baikonur.

Finnish researchers in cooperation with the Geophysical Institute at Kiruna are developing plasma spectrometers for the probes. These instruments weighing about seven kilograms study particles in space. The Finns are developing the data analysis aspect of the plasma spectrometers, plus the solar panels, doing the reliability calculations and part of the environmental experiments.

The manufacture of these Aspera instruments is Finland's first development project in space technology. It was begun in 1985. When the Asperas have been

sent, the next similar devices will be sent a year later with two Interball satellites to an orbit circling the earth.

Phobos cooperation expanded last year when we started developing the electronic analysis units of the laser system and its accompanying testing program for studying the surface of Mars's moon, Phobos, with the Germans. The majority of this work will be done by Hollming Electronics.

In Finland scientific research of satellites began immediately after the launch of Sputnik in 1957. Gustaf Jarnefelt organized a satellite observation activity at that time, first in Helsinki and then in Jokio.

#### Finland Only in First Lap

Finlandish space research even has its international stars: Yrjo Vaisala with his star triangulation measures, Martti Karvonen with his space biological research, Birger Wiik with the moon rocks brought by Apollo, Juhani Oksman with his studies of Aurora Borealis and Paul Kustaanheimo and Risto Arho with their orbit calculation techniques.

In spite of this Finland has not benefited space research much beyond a start. The research and development activities of industry, VTT and higher education used up 35 million markkas and 113 person years during last year.

Finland now invests about 11 million markkas in international space projects per year. It is estimated that 70 percent of this returns to Finland before long in the form of equipment orders, but for the large concerns these sums are still penny ante.

Space activity is divided roughly in three parts: space research, application of adaptations, plus the development and manufacture of devices and systems. According to the space program Finland should focus its scarce resources on space research, communication satellites, remote sensing plus hardware and methods technology.

Remote sensing consists of observation of the earth or its atmosphere from space or aircraft and analyzing the data, for example weather satellite pictures, thus obtained.

The potential of remote sensing is considerable. Nearly a third of the surface of the earth is still unmapped, and as the population of the earth increases the maps have to be updated constantly. And Finland's maritime traffic in the wintertime, for example, requires accurate information on weather and ice conditions daily. The estimation of forest resources, or their loss, is made considerably easier and more accurate with remote mapping. For example the water content of snow can be estimated and floods thus predicted. Finland now gets 40 percent of its precipitation as snow. Also mineral prospecting is very important for Finland.

Sometimes it is asked why even a small country like Finland should reach for the moon in the sky, when so many important matters are on earth, even in the scientific community, are not yet in order. The space affairs committee led by

professor Pekka Jauho answers the question thoroughly in its over 100 page space program:

Space offers many possibilities, on one hand for scientific research, on the other hand for activity aimed at direct benefits. Finland can not afford, nor has any reason to remain aloof of this development now taking place in all industrial nations. Economically Finland has equal possibilities for space activity with other small industrial nations, the program authors believe.

"The stimuli for space research are mostly technological. It is important that Finland should soon catch up with other western countries in this field. But space may also provide answers to many basic questions of mankind. For example, did Mars support life earlier, or is Mars now perhaps evolving in that direction?" says Risto Pellinen.

#### "Mars Rover" on its Way in 1992

In January USSR offered Finland a cooperative role in an entirely new Mars research program. The USSR has decided to expand its Mars research during the next decade. From 1992 on they will be able to take advantage of the "launch window" opening every second year due to the positioning of Mars and Earth. In addition to Mars, comets and asteroids will also be studied, says Risto Pellinen.

"In 1992 or 1994 an intelligent, 120 pound Mars-Rover will descend on the surface of Mars. It will analyze samples from the surface of Mars, even hundreds of miles from the landing and transmits the findings to a satellite circling Mars, from which the information is transferred back to earth.

"Of special interest are the twin balls lowered on the Martian surface, which in the daytime rise up and at night descend back to the surface. The balls will contain an 1.5 kilogram weather station, for which the skids may be built in Finland. In addition the balls will also hold three or four, one kilogram automatic weather stations, the so-called 'Mars eggs,' which the ball will lay at 600 to 800 kilometer intervals on the Mars surface to transmit meteorological information," says Risto Pellinen.

In addition to the USSR, Finland has a cooperative space research agreement with the European Space Agency, ESA. Cooperation with ESA began at the beginning of this year. Presently, at the request of ESA, Finns are developing hardware proposals for the so-called corner-stone program, which investigates physical phenomena between Earth and the Sun. The total costs of the venture are about 2.3 billion markkas.

Finland is taking part in the ESA science program with 4.4 million markkas this year, and, for example in the year 1992, with 16.9 million markkas. ESA's annual budget is 7 billion markkas.

"We will make seven or eight hardware presentations by mid-July. ESA will choose the devices to be constructed by the end of the year. Their construction will begin next year and they will be sent into space perhaps in 1994," Risto Pellinen relates.

The new generation plasmaspectrometer is also among the presentations; VTT is currently designing optical detection technology for it.

"Countless questions hover in the background of all research: Why, for example, does the earth's atmosphere leak oxygen into space? At the culmination of research looms a possible joint US-USSR manned flight to Mars around 2015," estimates Risto Pellinen.

He asks technician Pekka Riihelainen whether the computer "card" is ready to be sent to Moscow via Kiruna. This computer channel connector should arrive in couple of days. A disc the size of an envelope is part of a great space program.

"It's ready," the technician replies with flushed cheeks.

#### Control Station for Tele-X

About ten enterprises, which have production related to space technology, have been accepted into the Finnish space program. Among them the most important are Hollming's laser systems for space probes, Lohja's satellite televisions, Nokia's ground stations and guidance systems, Suunto's emergency transmitters and Vaisala's weather satellite receiver stations.

Satellite data transmission is economically the most significant area of space activity. Satellites are used extensively in telephone and data communication and in the transmission of TV programs. It is calculated that the development of new and inexpensive ground stations, plus land, sea and air traffic is in the process of creating new markets worth around 20 billion markkas.

Finland has many prerequisites for creating new products for these markets in the space field. Thus many enterprises are developing and manufacturing products, which technically are close to space technology, although at present they are being applied in other areas. Nokia's research director, doctor of technology and a member of the Committee on Space Affairs, Viljo Hentinen, tells us that he, along with his research team, is not headed for space, but will remain occupied with more mundane matters:

"We have concentrated on guidance stations and programs for satellites and on data transfer. We are focusing on the production of small ground stations and satellite television receivers."

Data transmission via satellite is going to grow explosively. Viljo Hentinen estimated that the markets for car, airplane and ship data communications links alone will climb to four-five billion dollars per year. "There are a lot of stiff competitors in the game, however," he says.

According to Viljo Hentinen, it is regrettable that Finnish space program is "bringing up the rear." ESA was founded already in 1975, but Finland did not join as a member until now. This clearly hinders Nokia's efforts to progress faster, since the competitors already have experience in joint efforts.

"In this field general recognition and image count a lot. We have invited top visitors from ESA and elsewhere, who are surprised at the high level of Finnish technological sophistication. Visits are a good way to inform people directly. But Finland also has to start from the ground up," says Viljo Hentinen.

He relates that so far they have managed to staff the 100 person research center, which he leads, with people from Finland. A few foreigners have also been added to the group: an American, a Norwegian and an Indian. The research director has also made rounds at American universities. On his trip he found three "lost" Finns, who are doctoral level top-flight professionals.

"Fellows who have gotten into the American universities, have something here," he says tapping his temple. These "finds" by the research director do not work in the enterprise's space program, but during the continuation the field will need new individuals.

Hentinen opines that Finland still has a long way to go to reach the level of the French example: University of Toulouse already has its own department for education and research in space technology. Nevertheless Finland also has at least plans on the burner. The Institute of Technology is already giving specialized instruction in course form on remote mapping.

Viljo Hentinen presents his recently completed pride and joy, the result of three year's work: a Tele-X control station. The station with its guidance and observation centers developed by Nokia's information systems team is for the Swedish space firm Rymdbolaget. The greatest portion of Nokia's work has been in the preparation of programs. Beside the simple-looking computer terminal is a small-scale model of the Ariane rocket to remind of the fact that Tele-X is intended to be shot into outer space in 1988-89.

"With the aid of this station one can watch that the satellite remains in its orbit and functions flawlessly. We have received recognition from ESA in this as a significant developmental step, as the older guidance systems have been fairly primitive," Viljo Hentinen relates.

The price of one guidance station is generally 20-30 million markkas, depending on the system and the satellite.

"One doesn't need to sell too many of them to have already made quite a profit," Hentinen smiles.

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CSO: 3698/502



## FRG BIOTECHNOLOGY PROMOTION MOBILIZES SMALL FIRMS

Duesseldorf HANDELSBLATT in German 20 May 87 p 6

[Article by hjs: "Small Enterprises Show Increasing Interest in Biotechnology"]

[Text] Bonn, Tuesday 19 May 1987--The indirect-specific Biotechnology Support Program, which only started in April 1986, has already shown significant progress.

DM 11.3 million in support funding had already been authorized until the end of 1986, with simultaneous generation of DM 20 million in private funds. These interim figures were announced in Bonn by Minister for Research and Technology Heinz Riesenhuber last Tuesday.

A breakdown by major points of emphasis indicates active participation in the program by enterprises engaged in instrument and equipment manufacture, bioreactor development, product preparation and production development, and biochemical laboratory work. Support funds were used also for developing biotechnological procedures involving cells and microorganisms having industrial significance.

The interim report indicates that by the end of 1986, 47 firms had lodged a total of 54 applications for support to research projects in this area. Eleven firms which were embarking on biotechnological problem areas for the first time were granted support funds for feasibility studies. Actual development phases in 27 projects were funded with amounts of up to DM 600,000. A total of 16 projects with application for about DM 5 million were still being processed by the deadline date. According to the ministry, they are likely to be approved.

At the same time, Riesenhuber reported on the status of the program announced in July 1985, concerning support for "Applied Biology and Biotechnology." It is devoted primarily to the development of a new key technology, the solution of present and future national problems, medical and agricultural research and to improvements in innovative conditions in the economy. The 1987 budget of DM 213 million is justifiable overall, in Riesenhuber's opinion. He stated that the funds had been allocated on a priority basis to the fields of microbiology, cell culture and cell

culture and cell fusion technology, bio-procedure technique and enzyme technology, as well as to plant and animal research.

The R&D minister cited the following examples, among others:

—biotechnological waste water treatment of industrial wastes which are heavily polluted or permeated by hard-to-dissolve, environment polluting chemicals, such as those generated in cellulose or paper recycling plants;

—biological rehabilitation of soils heavily permeated by organic chemicals. In 1986 a research association was established for microbial treatment of dioxin-containing soils. Its purpose is to isolate microorganisms for the removal of toxic substances and to develop technical cleanup procedures;

—in the field of biological compound production, the R&D ministry assisted in the formation of a research group linking the Federal Institute for Forestry and Wood Products in Hamburg, the Association for Fast-Growing Tree Species in Hannoversch-Muenden and the University of Munich; its objectives are expressed in the title "Biomassproduction with Fast-growing Tree Species." Its studies are to determine conditions necessary to use agricultural surfaces for biomass production, with wood produced in this manner being examined for its suitability for chipboard production or for use in energy production.

Riesenhuber believes that the entire biotechnology support program has "produced notable progress on a broad front" for both basic research and for economic and technological development in this area through the joint enterprise of independent activities of the federal Laender, the research support organizations and the national economy. This *modus operandi* is to be followed in the future as well.

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CSO: 3698/490

## GREEN PARTY LEADER ALLEGES BW EXPERIMENTATION IN FRG

Hamburg ALLGEMEINES DEUTSCHES SONNTAGSBLATT in German 24 May 87 p 2

[Article by Hinrich Luehrssen: "Hannover: Is the Bundeswehr Sponsoring Experimentation with Biological Weapons?—Researcher in the Twilight Zone"]

[Text] Professor Volker Moennig cannot understand what is going on. He complains that while his research is devoted entirely to "humanitarian purposes," he is constantly the subject of "defamation and slander." The unhappiness of the scientist from the Institute for Virology of the Hannover Veterinary College is directed at one of his former students, biologist and presently chairman of the Greens of Lower Saxony, Dr Manuel Kiper. The latter, a specialist in molecular biology, is convinced and has informed the public of the fact that the Hannover institute is conducting "research on potential biological weapons."

The veterinary college on the other hand considers the allegations of the Green Land chairman to be a "campaign of character assassination." Jointly with the Land government of Lower Saxony it succeeded in obtaining a temporary injunction against Kiper. If he were to continue stating that the Institute for Virology is conducting military research for biological weapons under contract to the Federal Defense Ministry, he would be fined DM 50,000. Kiper, who did not testify at the trial, has appealed this injunction; the appeal will be heard by the Hannover Superior Court. It will be a difficult task for the judges, who will have to fight their way through the thickets of molecular biology: are those pathogens with which the institute is working potential warfare agents, or aren't they?

The Green biologist found the scent of the "center for genetic engineering war research," as he refers to the capital of Lower Saxony, in the fall of 1985 by way of the answer to a minor request for information by the Greens in Bonn. At that time the Federal Defense Ministry confirmed that for the first time DM 5.9 million had been earmarked by the ministry for "development contracts for defense medicine." Kiper researched this and found, in line item 1420 of the budget, what this stood for. Among other things, there was a project entitled "Immunoprophylaxis for arbovirus infection," for which the defense ministry has provided the Hannover Institute for Virology DM 950,000 since September 1985. According to the



biologist, there is, among the arboviruses, the organism that causes Venezuelan horse encephalitis—in humans, it can cause encephalitis. Says Kiper: "In the United States this virus has been propagated as a BW agent for a long time." The Defense Ministry confirmed that the federal "Defense Science Agency for ABC Warfare Protection" in Munster is participating in the Hannover project.

In addition, Kiper's inquiries have shown meanwhile that there are connections also between the Hannover institute and the U.S. Army. To prove it, the Green biologist quotes from a trip report made by Prof Moennig about his stay at Fort Detrick, Maryland from 7 to 9 October 1985. According to Kiper, the high-security laboratories located there are the center of U.S. biological weapons research. Moennig noted that the U.S. colleagues are interested in close cooperation "with German institutes, especially the Defense Science Agency."

As further evidence for the cooperative efforts between civilian university researchers and the Bundeswehr, Kiper testifies that as early as 1983 the Hanover institute had worked on behalf of the Defense Science Agency in Munster on "the production of monoclonal antibodies against bacteria and toxins." At the time, he claims that maximum emphasis was being placed on the organism causing brucellosis.

Summarizing his impressions, Kiper says that "all in all, a piece of weapons research suitable for promoting the development of biological warfare agents." He concedes that vaccines by themselves do not constitute weapons. However, working on them provides the requisite basic knowledge for the production of biological warfare agents.

As far as Prof Moennig is concerned, the source of the research funds and the link with the Bundeswehr do not at all justify the Green biologist's complaints. The work, he says, is being reported at scientific congresses; there is therefore no question of secrecy. Nor are the results in any way suitable for BW weapons production. Says Moennig: "We do not manipulate viruses; we study their structure, their role in disease."

The Green biologist agrees with the virus researchers and the Bundeswehr insofar that the work in Hannover does not violate the 1972 BW weapons agreement, which the FRG has joined. While the agreement forbids the use, development, production and storage of BW weapons, it permits work for defensive purposes. The Bundeswehr press and information service therefore considers vaccine research to be a medical preventive measure for the protection of military personnel.

Kiper justifies his attacks by saying "I only want to point out the weaknesses." He believes that progress in genetic engineering greatly facilitates the development of vaccines against viruses which are suitable for BW agents. And immunization, he says, is a prerequisite before the military can use any BW weapons at all. Without adequate protection, the BW agent would cause catastrophic effects among the users. The

Bundeswehr's reply to this can be that it must protect its soldiers from potential enemy BW weapons.

Other scientists have their doubts also about the purely defensive character of vaccines against potential BW weapons, among them Prof John Collins, a virus expert of the Society for Biotechnological Research in Braunschweig. On the occasion of the forthcoming court action he directed an appeal to his colleagues: anyone engaged in working on projects of this nature should be mindful of his responsibilities.

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CSO: 3698/490

## FINLAND: ORION ACQUIRES FARMOS TO PREVENT FOREIGN FUSION

Helsinki HELSINGIN SANOMAT in Finnish 30 May 87 pp 3, 34

[Article by Renny Jokelin: "Pharmaceutical Enterprise, "Farmos," Comes Under Orion's Control"]

[Text] The competition for the control of the Turku pharmaceutical firm Farmos was resolved with a stock trade Friday. Orion became the chief Farmos stockholder, which together with Osuuspankkien Keskuspankki or OKO have the majority of Farmos shares.

No information was provided about the new distribution of shares, but Orion probably has over 45 percent of the shares and the votes.

The companies involved said the objective of the arrangement was to "stop idle speculation about the ownership of Farmos." According to Orion's chief director, Matti Kavetvuo, Orion made its decision so that Farmos would not drift into the hands of foreign pharmaceutical companies.

The names of the foreign raiders were not mentioned by the involved parties. However, it is known that the Swiss Ciba-Geigy and the Swedish Astra had shown interest in Farmos. Also in February a development company Spontel which wanted to fuse its own Tamros with Farmos.

Orion as Main Farmos Shareholder

The healthcare concern, Farmos, in Turku was transferred to the camp of the Orion company. With the transfer of shares on Friday Orion became the largest single owner and, according to director Matti Kavetvuo, "together with OKO has a majority."

Orion reportedly received over 700,000 Farmos Series I shares and 140,000 new Series II A shares in OKO's internal trading at the exchange. The value of the trade was altogether 431 million markkas. Other smaller deals were also made with the shares.

The parties to the deals did not reveal the extent of Orion's or OKO's new ownership in Farmos, except that they now jointly controlled a majority. If

all the paper traded on Friday ended up with Orion it would have 45 percent of the Series-I voting shares and one-third of the Series-II A.

With them Orion would possess over 45 percent of the votes in Famos. The chief director of Orion, Kavetvuo, said that Orion acted now because Famos shares were sought by a foreign medical concern. Kavetvuo did not mention names. It is known that the Swiss Ciba-Geigy and the Swedish Astra companies had been most strongly interested in Famos.

OKO, which previously had directly controlled 41 percent of the shares with its pension funds, foundations and regional banks, collected the share pot. Also among those giving up their shares, according to Valio's director Iikka Haka, was Valio, which at the turn of the year had 10.6 percent of Famos shares.

Among those owning large shares of Famos, in addition to OKO and Valio, have been the insurance companies Tapiola and Sampo as well as the Federation of Agricultural Producers, MTK.

#### "Controlled Structural Change"

Director Kavetvuo and OKO's chief director Pauli Komi also defended their deal by saying that it ended the speculations about Famos's future and assured the company industrial peace.

Cooperation between Orion and Famos is being intensified, among other things, in exports, foreign activities, research and production. Kavetvuo said that another objective of the deal was to "improve the international competitiveness of Finnish medical industry."

Kavetvuo said he had discovered the use of the term, "controlled structural change," in this context along with manager Matti Liukkonen."

The trade was made, according to the involved parties, through the exchange so that Famos's status as an exchange firm would be preserved. This is why Orion is not interested in Famos's plurality, according to Kavetvuo. Orion company is quoted outside the exchange on the so-called broker's list. The companies also saved a little on stamp taxes by going through the exchange.

The firms gave assurances that they had no intention of striving for a concern relationship with the Famos company. The companies assume that: "In the long run the advantages of cooperation will positively affect the value of Famos shares.

Orion paid half of the 430 million markka deal and OKO financed the other half. At the same time OKO will become a minority shareholder in Orion. Orion is directing 350,000 of its B-shares to OKO. The amount is about 5 percent of Orion's shares, but less than half percent of its votes.

OKO also became a significant financier for Orion. The Kansallisosakepankki, however, will remain as Orion's main source of funds.

## "OKO as Pure Investor"

Komi said that OKO gave up a large package of Famos shares and went along with Orion, because OKO has always been purely an investor in the medical field. "I also believe that the professionals in the field will better take care of Famos's affairs than the bankers."

The development company Spontel aspired to Famos control in February but the deal fell through because of ownership disputes between Spontel and Sponsor.

Orion's business volume last year was 2.1 billion markkas and the company employed 4,345 individuals. Orion has made an excellent showing during last two years. Last year's net profits were over 200 million markkas.

Famos company's turnover was 800 million and it employed 1,750 individuals. Famos's net profits were 36 million markkas.

Famos has succeeded relatively better in its product development than other health-related Finnish enterprises during the last year. Kavetvuo also offered his recognition of this fact on Friday.

## Reorganization of Wholesale Markets to Follow

Famos has now been situated exactly where it was originally intended. A year ago Orion and members of the Agricultural Federation bargained over Famos, but their deal fell through over money. Orion was not ready to pay sufficiently for Famos control.

Famos also interested foreign pharmaceutical giants and the development company Spontel. Spontel had clear aims toward the medical field and Famos. Spontel had made a plan, which it later managed to get the drug manufacturer and distributor, Huhtamaki company, to join.

During the first phase Spontel was supposed to buy the Tamro concern, which has two drug manufacturing and one wholesale businesses.

Then Spontel was supposed to take over Famos.

In the third phase Spontel was to sell the drug manufacturing units of Tamros and Famos to the Huhtamaki concern. In return Huhtamaki was to give up its wholesale drug distribution in Tamro's favor.

The end result of such arrangement would have given Spontel control over two-thirds of the drug wholesale market and Huhtamaki two-thirds of the drug manufacturing in Finland. Orion would thus have been floored in both areas.

The first phase of the plan, or the purchase of Tamros, was realized a year ago in June. The Famos deal was supposed to go through last February, but the venture fell through at the last minute over the internal wrangling of Spontel's young lions.

Dressed in black Spontel and the Pellervo waited in vain over a long weekend with pen in hand for papers to sign. The credit union bankers at Famos, who had been making leadership-like noises, did not dare to get on the development company train and left the deal unsigned.

The plan, however, has been carried through in part. In April Spontel sold its Tamros drug manufacturers Star and Rohto to Huhtamaki. These manufacturers had no great significance for Tamros as they were simply too small by themselves.

Next arrangements will be made in the wholesale hierarchy just as planned; Huhtamaki will sell Laaketukku to Spontel as a partner for Tamros. Cooperation between the companies is already going well.

Orion, however, has not been floored. With Famos its drug sales will gross over a billion markkas. Huhtamaki's gross will reach a good 600 million. Orion's share in the wholesale market is now one-third, but its position will be strengthened when Famos products eventually will be transferred to it.

Orion had to pay for its procrastination. A year ago one Famos share cost just about what it does today. During the year, however, two issues of stock have taken place and as a result the number of shares has nearly doubled.

Now Orion received nearly half of Famos for 430 million markkas; a year ago it could have gained control for the same amount.

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CSO: 3698/500



## FINLAND: NOKIA'S INTERNATIONALIZATION, GROWTH DETAILED

Stockholm SVENSKA DAGBLADET in Swedish 14 May 87 p V

[Article by Lars-Georg Bergkvist]

[Text] Next Thursday Kari Kairamo, who is both board chairman and group president of Nokia in Finland, will be elected to the Volvo board.

In this way Nokia, which is sometimes called "Finland's Volvo," will take yet another step toward the internationalization that has characterized the group during the past few years and has also included a listing on the London Stock Exchange.

Of the six foreign firms listed on the Stockholm Stock Exchange, Nokia is the favorite among investors.

So far this year, three of these six companies-Hydro, Norsk Data, and Kone-have simply followed the rise in the index, with the value of their stocks going up just over 10 percent.

The other three have gone downhill. Danska Nordiska Fjaer has dropped by almost 18 percent, while the Finnish companies Wartsila and Nokia have risen faster than the average stock: by 20 and 31 percent, respectively.

The rise by Nokia is noteworthy, since the company was also one of the fastest climbers on the market last year. Its stock value rose by 98 percent in 1986.

It is hardly outstanding final results that have attracted investors, however. To be sure, profits increased by 22 percent to 675 million markkas last year.

But profitability was only average, at 11 percent return on adjusted paid-up Capital. That is far below the group's goal.

Instead, it is the expectation of a continued successful restructuring and internationalization of the group that has driven up the p/e ratio to almost 20.

Nokia is a typically Finnish conglomerate that is unlike anything in the other Nordic countries. The group consists of a combination of basic industries and high technology that cannot be found in Swedish industry today.

#### Finland's Largest

With gross sales of 12 billion markkas last year, it was Finland's largest private company. The electronics sector, which is only about 10 years old, is growing most rapidly and now accounts for about 40 percent of total sales and 35 percent of the group's total profits.

This sector includes mobile telephones (where Nokia has the largest share of the European market) in which sales increased by 35 percent last year, telecommunications which noted sales increases of 53 percent last year, computer systems, and radio and TV sets produced by the combined Salora-Luxor division. Luxor is now totally owned by Nokia.

In addition, the group has also retained most of the basic industries from which it originated. The largest of these are the paper and cable divisions, which have annual sales of just over 2 billion markkas each. It also has cable, metal, rubber, and chemical plants. The group even has its own weapons factory.

The group also has large hidden resources. It is Finland's largest private power producer. There is no market evaluation of these resources in the annual report, however.

#### Pioneer

Nokia is also a pioneer on the Finnish capital market. Last year the group made a special issue of new stock on the American market and a new issue in Finland and Sweden, bringing in a total of 655 million markkas of new risk capital. The group attracted much attention last year when it linked dividends to profit trends and the board has recommended that stockholders approve an amendment to the corporate by-laws that would make it possible for the company to become more active in its financial dealings.

Despite the many areas in which the group is active, President Kairamo has undertaken an intensive structural change in the group during the past 10 years. During the past 2 years alone, forests and other activities have been sold for over 0.5 billion markkas. It has also purchased a number of companies—some of them in Sweden.

The restructuring will continue at the same pace, the president promised. But he is not yet prepared to give up the concept of a conglomerate: regardless of the financial climate, the group always has sectors that are doing well and that are capable of generating growth.



## Sell Basic Industries

The question is whether or not this can continue in the long run—whether the leadership will manage to control a group with such diverse activities, especially since some of them—cable and forestry, for example—are already full-grown. It would come as no surprise if, during the next few years, Nokia were to sell one or more of its heavy basic industries so that it could concentrate more on growth areas such as electronics.

For even though the group has been surprisingly successful in electronics, the competition in this field is unrelenting. One of Nokia's weaknesses is its lack of an internationally established trademark. Nokia sells mostly to other systems manufacturers.

It takes a long time and enormous investments to launch a new brand name and to build up a retail network on the big markets.

9336

CSO: 3698/504

## FINNISH BIG FLAT PANEL DISPLAY WITH INDUSTRIAL APPLICATIONS

Helsinki UUSI SUOMI in Finish 6 Jun 87 p 48

[Article: "First in Europe to Have its Own Flat-Screen TV: Lohja Electronics Firm Now Seeks Support from the Japanese"]

[Text] Lohja Oy is strengthening its contacts with the Japanese electronic giants to develop a flat-screen color television display. On Friday the company touted itself as the first manufacturer in Europe to produce a wide-screen TV based on its own black-yellow flat panel display.

Lohja's Finlux large-screen television set has the largest flat screen picture area in the world at the moment.

In practice this means a seven inch panel, while the picture size of the pocket television sets with a flat display developed by the Japanese to date has been in the 2 - 3 inch range.

A commercially reasonable color flat display can probably be expected in the first half of the next decade. The development chief Goran Wahlberg estimated that it would come on the market in 1993-95.

The final objective is a large-screen color television set in the one meter size.

The giant project is capable of being implemented with Lohja's electroluminescence technology.

On the other hand, using current picture tube technology a display of that size would weigh half a ton and would be five meters thick - thus not at all a large screen television that could hang on the wall of any home.

#### New Receiver Too

At the same time Finlux has developed a new TV receiver for the the panel of the flat-screen displays.

The receiver component (TV without a monitor), which was manufactured using the newest technology, is approximately the same size as a large automobile stereo.

The development of flat-screen television has been concentrated almost completely in Japan. Philips and Thompson, which have studied flat-screen applications in Europe, have themselves operated using Japanese licenses.

When actual sales begin, the price of flat-screen television sets will probably be "competitive," according to Lohja.

For example, the price of a receiver using digital technology and new microelectronics in mass production will probably be around five percent more expensive than that of equipment of a corresponding level using the old technology.

Lohja has also very quietly succeeded in improving one of the worst shortcomings to date in the flat-screen display: its current consumption has fallen by half in a year.

The result has direct commercial benefit for Lohja's industrial electronic side.

Photo caption: Development chief Goran Wahlberg holds a receiver with a flat display screen in his hand. In the background there is a comparable flat display mounted on the wall. The product is not intended to be marketed to the consumer, but research on developing a large color display is continuing.

1289j

CSO: 3698/540

## OECD COMMISSION REPORT ON FINLAND'S S&amp;T RESEARCH POLICY

Helsinki UUSI SUOMI in Finnish 5 Jun 87 p 7

[Column by Pekka Haarla, Geneva correspondent for UUSI SUOMI: "OECD and Finland's Science"]

[Text] A group of scientists from the OECD has acquainted itself with research work on the technical level in Finland and given it high marks. The international group led by the English professor C. Freeman stated that Finland's science and technical research policy is on a high level and that the country has considerable scientific and technical potential.

The group considers the development that has occurred in our country to be almost unique, while noting that the development has taken place relatively disjointedly, for which reason the group emphasizes the importance of coordination throughout the line.

In the favorable report there are also suggestions about matters in which the group sees room for improvement. Prominent among these is intensifying the training of scientists, so that achieving the doctorate would be possible in a shorter period of time after graduation. According to the report the Ph.D. degree is attained in Finland on the average at the age of 35, which is very high, compared with other countries.

From this it follows that industry is not eager to hire scientists at this age into its service but rather settles on younger, less trained scientific personnel. The small number of those in industry in our country who have higher degrees surprised the group.

In addition, the high age of the Ph.D.'s has caused an oversupply at the university gates, where those who have obtained their doctorates are forced to accept low-ranking jobs.

In order to remedy the situation the group recommends that Parliament approve funds to carry out the proposal made by the minister of education in 1983 regarding the intensification of higher education.

With regard to industry attention was directed to the lack of tax breaks for donations made for the universities' research work. Through these donations

industry could promote basic research that can best be done within the universities. In addition the modernization of the universities' apparatus would increase industry's interest in cooperation with the universities' research facilities.

Special attention was devoted in the report to TEKES [Technology Development Center] and its role. According to the report TEKES is mainly encouraging the development of new technology, but the group indicated that developing basic sectors is also important and expressed its doubts that our country's pulp and paper industry had done all it could in this respect.

The group proposed that TEKES's field of responsibility include as acting as an intermediary for small and medium-sized industry.

With regard to the amount of money used for research Finland is already in the international middle class. In the comparative table Finland has already passed Austria and Denmark and belongs in the same class as Norway and Belgium.

12893

CSO: 3698/540

## FINNISH SPACE COMMISSION PROGRAM: FOURFOLD BUDGET BY 1992

Helsinki UUSI SUOMI in Finnish 6 Jun 87 p 49

[Unsigned article: "Broad Program from the Advisory Commission for Space Matters: Fourfold Increase in Financing for Finland's Space Activity"]

[Text] Finland's first space program has been completed. The Advisory Commission for Space Matters submitted the program to Minister of Transportation Pekka Vennamo (Bural Party) on Friday.

In the opinion of the advisory commission Finland should concentrate especially on space research, satellite communications, remote sensing and equipment manufacturing.

The Advisory Commission on Space Matters proposes that the financing for space activity be raised from the present 20 million marks per year to four times that amount by 1992. The advisory commission stresses that Finland's opportunities in the space field are based on international cooperation, so this should continue to increase.

Minister Vennamo, who received the broad space program, expressed the opinion that our country needs a national center for space activity. In Vennamo's view a working group should be established to work out the development of an organization for space activity.

Since the beginning of this year Finland has officially become a member of the space club through joining the European Space Agency as an associate member.

At the beginning of the year Finland also concluded an agreement with the Soviet Union concerning cooperation in the field of the peaceful study and utilization of space.

Space research has been going on in our country for a long time, however. Industrial activity applying space technology is also developing all the time. The activity is financed on the one hand directly through the research institutions' and industry's own financing and on the other hand as project financing primarily through the Technology Development Center and the Finnish

Academy. This year project financing amounts to a little over 20 million markkas, half of which is used for the costs of participating in the ESA space organization.

#### Applications Down to Earth

A notable application of space research is the international transmission of telecommunications and television programs through satellites. Satellites are also a part of contemporary weather forecasting. Locating satellites can be used to search for wrecked ships or planes that have crashed, for example. Through the use of remote sensing, on the other hand, the condition of forests and the ice situation for seafarers, among other things, can be studied. Satellites can also be used for navigation.

According to the advisory commission Finland at present still has relatively few researchers in the central sectors of space research. It is recommended that the number of research and teaching positions in the field be increased and that education in the field be strengthened.

It is stated in the program that government support for industry utilizing space research is indispensable. This is the case because the costs and risks of projects are too great for companies to bear alone. Several applications of space technology have also been developed for the needs of the public sector.

Participation by Finland in manned space flights, which had been talked of at one time, did not thrill the advisory commission. The advisory commission felt that manned flights would not bring the kind of benefits that would be important for the objectives of our country's space activity.

12893

CSO: 3698/540



## HUNGARY: NO FUNDS FOR WINNERS OF RIGHT TO IMPORT COMPUTER COMPONENTS

Budapest COMPUTERWORLD/SZAMITASTECHNIKA in Hungarian No 8, 22 Apr 87 p 1

[Unsigned article: "What Will Become of You, Little Machine?"]

[Text] A restricted team of domestic personal computer manufacturers, assemblers and importers are in a favored position. After winning the OMPB [National Technical Development Committee] competition they can have state support to set about realizing the government level resolution, to improve domestic PPC [professional personal computer] supply. When, on one of the first really beautiful days of spring, we invited the managers of Cosy, Videoton, PerComp, Proper and the Csepel Association to a conference we were sure that the self-confident winners would shower each other with business offers and seek together a way favorable to everyone, not to say an optimal way, to spend the state dollars.

But the faces of the participants were shadowed by clouds of care instead of optimistic good feeling and all-illuminating sunshine. The first quarter of the year is past and the winners have not gotten one cent for parts import. The earlier acquisition sources have dried up and citing the difficult economic situation, and the promised state support itself, there is no possibility for a compensation deal. The customers are already waiting for the promised cheap computers so it is difficult to sell existing inventory and the market is falling apart. The manufacture of parts which can be produced at home had to be started, investments are beginning, and the risk to those involved grows day by day.

And while the winners of the PPC competition talked, as guests of our journal, about how a survey of their cooperation possibilities had to wait for the possibility of computer manufacture, assembly and import--wait until they finally got the support won--the Council of Ministers established at a session that very day that the unfavorable trends of 1985-1986 had continued, our foreign trade balance had deteriorated further, non-ruble accounting export had declined by 6 percent and import had increased by 10 percent.

Sandor Moricz, director of Cosy, thinking of the Primo and the Pro-Primo, sighed deeply: "We are really not surprised at anything; once before we almost stumbled into winning a competition."

Even in this economic situation his good humor did not abandon Emil Kindzierszky, chief engineer of the Csepel Transformer Factory: "Will you now come out with a Pro-Secundo?"



## HUNGARY: WINNERS OF COMPUTER PARTS IMPORT CONTEST CONFER ON AGENDA

Budapest COMPUTERWORLD/SZAMITASTECHNIKA in Hungarian No 8, 22 Apr 87 pp 6, 7

[A roundtable talk organized by the editors: "What Will Become of You, Little Machine?"]

[Text] The winners around the table were Gabor Iklody (director general of the EMO [Elektromodul Electronic Parts Trading Enterprise]), Pal Nemeth (managing director of the SZKI [Computer Technology Research Institute and Innovation Center]) and Istvan Petocz (chief engineer, HTSZ [Communications Engineering Cooperative]), all from the Proper Association; Mrs Csaba Megyesi (sales) from the Videoton Computer Technology Factory; Gabor Szeles (president of the Instrument Technology Cooperative), Peter Vadasz (chief engineer, Microsystem) and Tamas Schreiber (Microsystem), these three from the PerComp Association; Emil Kindzierszky (chief engineer, Csepel Works Transformer Factory) representing the Csepel Association; and Sandor Moricz (director) and Laszlo Majtenyi (technical director) from the MTA SZTAKI Cosy [Cooperative Systems Subsidiary of the Computer Technology and Automation Research Institute of the Hungarian Academy of Sciences]. The Computerworld Informatics company and the host journal (CW-SZT) were represented by managing director Dezso Futasz, editor in chief Elek Nagy and correspondent Janos Andor Vertes. The time was the end of the first quarter of 1987. The mood--as Janos Brody would say--was good but not hopeless. Questions of the possibilities of the national economy constantly mixed into the theme of the possibilities for cooperation.

Gabor Iklody: In order for the foreign trade balance not to deteriorate further imports should be cut by more than 10 percent compared to last year. In contrast to this the data for the year so far show an import overage of more than 100 million dollars monthly. Negotiations are taking place and there may be some hope that the necessary reductions will not be realized in every branch of industry in the same way. We would like it if electronics could stay at last year's level and let metallurgy, the chemical industry and the machine industry take over a larger share of the import reduction. The government will decide about this. But it must be seen that the support which the chief authorities announcing the competition promised to improve PPC [professional personal computer] supply cannot be gotten from anywhere now, it simply does not exist. Our maximum dream might be that what we used last year we might spend this year also on import of electronic parts. We also know that the plan counts on a 12-13 percent development of the electronics industry and we are a

bit mystified by the forced restrictions. All this does not mean that we here today have nothing to talk about, for the way things stand may make it even more necessary to find the reserves lying in cooperation. Let me say that although the electronics industry of Hungary looks back on a past much greater than that of Taiwan still in the latter country, within 10 years, electronics has grown into a branch producing the larger half of the national income. There is specialization there even in the area of subassemblies, most manufacturers there buy parts from other countries of the area too. For my part I believe that it would not restrict the domestic possibilities if the computer technology card and parts assortment were uniform. In the name of the EMO I gladly offer my colleagues, I will import free, without a tenth of a percent of extra charge, the requested components for anyone who can name a cheaper but also reliable source. I would see such a deal as profitable even without a profit measured in percentages.

CW-SZT: An offer has been made, certainly not today for the first time. Let me ask: Would it hurt the interests of anyone among the winners (and if so in what way) if acquisition became more uniform with the acceptance of the cheapest supply, at the same time a tested, checked, quality supply?

Sandor Moricz: We have collected very many offers from Far East firms; we would be glad to turn them over.

CS-SZT: Cosy feels that these goods are cheaper?

Sandor Moricz: I did not say that, nor did I say the EMO was expensive, one has to see....

Gabor Ikloody: That's the way it goes. Everybody wants to play but nobody likes to turn over his cards. Turn over your cards! No dealer is a relative of mine, show your cards! Experts should decide which is the better offer. But blaming the supplier doesn't help....

CW-SZT: We got a West German offer, right after our article. Simply so there will be a card turned over, does anyone have an opinion about these prices? In any case one can see from them that the prices fall as a function of number of units, although it is a fact that the unit price reduction from one to 50 is 20 percent while increasing volume between 1,500 and 4,000 units means only a 1-2 percent concession.

Peter Vadasz: Let us look, say, at a disk drive, for example, this is 30-40 percent cheaper in Singapore. But I don't think this was the essence of the question, rather it was something like this: Do we trust in--let us say--the EMO to import parts for the sake of uniformity, handing over our "prize money" or a part of it? Isn't this question rather early? We have a couple other things to talk about first. We should know that right up to the announcement and judgment of the competition a market or at least market type conditions had developed in the PC area. In recent years I have seen a real competition struggle in Hungary in two areas--one is taxis and the other the world of personal computers. Everybody got marks or dollars anyway they could and tried to use them to buy the cheapest possible machine, and to sell the machines as dearly as possible. If these are the rules of the game then I will not tell

the competition where I buy more cheaply or how I got the wherewithal. The intervention--let us be precise, the promise of state intervention--changed this picture immediately. Let me add, I consider the original idea entirely good and rational. But what happened in the end is not good. Now one can get so-called expensive machines--but not for long, because for a month they have not authorized compensation deals....

Pal Nemeth: Excuse me, one can get them, but demand for them at the moment has stopped, and a completely confusing situation has developed.

Peter Vadasz: That's right, thanks to the press and our good offices everyone has heard something about the so-called cheap machines, which we increasingly suspect may not come. And if they do! We know very well that 4,000 machines is way under the demand! This many were bought last year, needs do not grow linearly, and in addition a significant price reduction will appear on the supply side, which will certainly increase demand. So how long will cheap prices last? Will there be any support? We do not see clearly. There are promissory notes, promissory notes can be withdrawn, the very well worked market has become completely tangled. In such a situation I consider it too early to ask if we trust in the EMO to get together the import needs for 4,000 machines at the best possible, cheapest prices. What can one say? Only a yes fits sober logic! But this country needs more than the 4,000 uniform machines imagined by the chief authorities who announced the competition. The chief authorities forgot about printers, streamers, color monitors, networks and software; and these "little things" make up two thirds of the acquisition price. How can we make these uniform?

Gabor Iklody: Is it certain that we must import everything, and must import everything from the West? Printers for example. There is a warehouse inventory of nearly 4,000 Datacoop printers. Maybe the price of 40,000 some odd forints is expensive. We would have to talk with the enterprise about this. Or take the Telephone Factory printer. Who among those dealing with computer technology knows about it? Who has tested it? Who uses it?

Emil Kindzierszky: We should add that the Poles also have an outstanding printer, which I have tested. It is completely compatible with the Epson and I say it is better.

Gabor Szeles: We should also note that there have been certain partial achievements here. In the area of printers, background technology, printed circuit manufacture and other things. The intellectual capacity is scattered but it exists. If this were brought together cleverly it might serve Hungarian industry much more efficiently, and save import money. It is true that the achievements are not always competitive, or are competitive with import goods only in an expensive way. But if we give up these efforts then we may be doing to computer manufacture what we did to the auto industry. Many may not care that we have to rely on imports, because it is probable that we would have aimed not at a Porsche but rather only at the Trabant, Wartburg, Skoda, Lada category, and then what. But now we have no engineers who could design even a Trabant! When I say that this money should also be used to create a background industry I know very well that even today there are subassemblies which are imported as parts more expensively than at the card level. But that is no

reason to give up the idea of IC level manufacture. We must find a solution. I do not believe that the Taiwanese would maintain themselves on state support!

CW-SZT: We are not saying that we consider the uniformization of certain elements to be rational only in the area of import. Let us talk about manufacture, about power units, let us say, to have a concrete example. The cooperative industry and Csepel Electronic supplies their machines with domestic power units, perhaps not out of price considerations but rather because of standards requirements. Couldn't they make the others a favorable offer? The problem here is not really that the customer circle is different, that the configuration must deal with different tasks! Or let us talk about the SZKI keyboard patent.

Gabor Iklody: I believe that today, after the burning down of the Microelectronic Enterprise, every electronic product manufactured here has to have an import content. In the great majority of cases this is at least 80 percent.

Gabor Szeles: I happen to have a fresh example contrary to that. The retail price of one of the network coupling cards in the FRG was 1,500 marks in March; the wholesale price was 700-800 marks. Since we manufacture this card we were able to compete with our Canadian competitor only by going down to 380 marks, and so signed a one million mark deal at the Hannover Fair. Let me reveal that the import content of this export is less than 50 percent. So it is true that if we want to waste Hungarian intellectual energy on standard things and want to manufacture, let us say, mother boards then we will really lose on the deal. But if we have a design staff capable of moving on to the new with lightning speed and if we can put new cards on the market then it is worth while to manufacture at home. We know very well that this network card has a maximum of 6 months, then we must make something new!

Pal Nemeth: I also feel that these are the key questions, but let us look at the competition which was announced. In my opinion the greatest merit of the decision was that certain accomplishments became comparable. Let us admit that earlier there was very rarely a distinction in the price of a configuration between routinely used devices sold in large numbers and the options, special products for special needs. There would be no sense in our theme, whether united action is possible in some questions, without this clarification, simplification, delimitation. In my opinion in the case of those mother boards and series elements in which we follow the world standard--for the sake of compatibility if nothing else--it is not probable that any special technical idea or some significant added value would make domestic manufacture economical to any great degree. At the same time, we have great opportunities in the area of supplementary equipment and options. This distinction could also aid in having the user see more clearly. Advertising the basic configuration and the price of the basic configuration in this form would in itself indicate what those parts are in which the added intellectual value is less. Designating the basic configuration would also have an orienting character, because this would also show that in themselves the basic configurations cannot satisfy user needs. It would also indicate that there are no essential differences here, so there is a real possibility for cooperation. I believe that all of us would be glad to get well documented,



supported bids for any subassembly, let us take a power unit as an example. The power units manufactured by the SZKI are thought to meet the MEEI. Independent of this, if we got a more favorable bid, if this makes manufacture more economical, we would accept it. We also made an offer, we sent our bid to every winner of the competition for an operating system making up a part of the basic configuration. We offered our 29,000 forint operating system for 9,900 forints. We are ready for similar cooperation in the area of other software. And I am informed that the Ganz Instrument Factory sought out everyone sitting here in regard to keyboards....

Gabor Szeles: Not us.

Emil Kindzierszky: Not only did we not get an offer we didn't even get an answer to the offer we made three quarters of a year ago on taking over the manufacturing rights.

Pal Nemeth: I will look into it, I can only say that we would be glad to study the possibility....

Peter Vadasz: I also am excited because we listed keyboards among the four subassemblies which certainly had to be imported. Monitors, Winchesters, floppy disks and keyboards. It would be good if we could get them here at home....

Emil Kindzierszky: In any case the keyboard is ingenious, I can say that to everyone here.

Istvan Petocz: The Ganz Instrument Factory did come to us and brought a keyboard. We asked for an offer, they promised one for Friday, many Fridays have passed since then.

CW-SZT: It appears that it would not hurt if we put these offers on the table because it seems there have been "bilateral discussions." For example, we received a letter from the Metal Processing Industrial Cooperative about which we believed that everyone knew of it, like bad money, we did not want to read an offer made on a computer cabinet. But on the basis of what has been heard we have a question. Is it possible that someone does not know that they would undertake to make 20,000 cabinets?

Gabor Iklody: I know about it, and I must say that the design is very ingenious.

CW-SZT: No others?

Gabor Iklody: I know about it only because a West German brought it to me. I did not even know where this cooperative was; it turned out to be two streets down, in District XIII. It is really shocking how much we do not know about one another here on the domestic market and how much we hide information about the foreign market. Everyone could satisfy special needs, everyone could compete with the others, while using a uniform parts or element assortment. When I came home from Taiwan the first thing I did was to pass on the bids to everyone. First to Videoton, then to Instrument Technology....

Emil Kindzierszky: There is a very important question about which we have not yet talked and that is why those who announced the competition came out for the IBM machines. We are inclined to forget that the only thing justifying hardware compatibility is to be able to bring into the country all the energy, capacity and intellectual work embodied in software. I can accept this standard only if this is included, something on which they sacrificed many thousands, tens of thousands of man years in the West. Now we are talking here about how we can produce the devices for all this. If we can be united in this then in my opinion it will be very good for Hungarian industry and the Hungarian economy and I trust that we will not each of us pay for it separately. On this basis everyone can have his developmental ideas and business as he likes. When we learned the results of the competition we asked for bids from those firms with which we were in contact in any case. The announced competition--it appears--did not have such negative effects on the foreign market as on the domestic market. The firms--seeing that they had to compete now for real interests, for shipments significant for us--reduced their prices by 15 percent.

CW-SZT: Since we are talking about price offers we would like to hear the price offered by the Transformer Factory for the power unit. It would be safer to tell it now than to write a letter.

Emil Kindzierszky: We have a 250 watt power unit; it is suitable for both the XT and AT category, at 17,000 forints.

Peter Vadasz: Sold.

Gabor Szeles: We would at least like a sample, we will test it, and if Csepel Electronic [previously, the Transformer Factory] will undertake delivery with guarantees we can talk about it.

Emil Kindzierszky: If I get the import needed for it!

Peter Vadasz: No problem. We were thinking of a compensation deal.

Emil Kindzierszky: Then I will mention a standardization possibility without an import need. The mechanics, it is true they are good only for the XT, because of their height, are being made by the Communications Engineering Cooperative on the basis of our own documentation.

Gabor Szeles: How many have been made, where can we see them, how much do they cost?

Emil Kindzierszky: They have made 120 units; we get them from the HTSZ [Communications Engineering Cooperative] for 3,200 forints.

Sandor Moricz: It would be good if we could get samples.

CW-SZT: We hope that this impossible, schizophrenic situation will not last much longer and that the winners will get the state support which they have won and for which they have since made considerable material sacrifice,

starting manufacture of subassemblies. We do not want to draw a lesson from the discussion, there are too many lessons for that. Let us only repeat why we convened this roundtable discussion. We know from Janos Neumann that in strategic games competition and cooperation are much more effective when combined with one another than they are separately. Well, we would like to aid the practical application of this game theory thesis, naturally only with our own tools, that is by making public this--what was it, a business discussion, perhaps a get acquainted evening? In any case, this roundtable discussion.

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CS0: 2502/65

## HUNGARIAN VERSION OF COMMODORE 64 UNDESIRABLE

Budapest COMPUTERWORLD/SZAMITASTECHNIKA in Hungarian No 8, 22 Apr 87 p 8

[Letter to editor from Csaba Andor]

[Text] In the fifth issue of your journal this year there was a reader's letter by Peter Matyas with the title "Should We Support Taiwan?" I would like to debate with what was said.

Peter Matyas would like to see a domestically made computer at the Commodore level. Well, I definitely would not like to see such a machine. In the first place I would not because even if it could be realized it would not save the 5 year advantage of the Commodore which is embodied in several tens of thousands of machines sold in Hungary, about 30 volumes of Hungarian language documentation, the experience and expertise of several tens of thousands of people, the extensive service network and thousands of programs. In the second place I would not because lacking a market it could not reach the series size which would make it competitive in price. In the third place I would not because the life curve of 8 bit machines has already reached the down trend even in the home computer category.

Even shortly before its market appearance, informed people could say of the Primo, mentioned by the author, that (let us not fear to say it) it was doomed to failure. For reasons of space I will not list the reasons why but to give just one, they began to sell the C-64 in Hungary with a magnetic disk unit (among other things this is why it became a successful machine in office applications) while they only promised a magnetic disk unit for the Primo. And so that my statement will not appear to be a prophesy after the fact I will add the prediction that within this decade not one Hungarian manufacturer has a chance in the home computer category, that in regard to numbers the foreign machines will predominate in 1990 even if strict customs measures are introduced in the future.

Your readers complain that there was little debate on this theme. Well, if they read more attentively the two or three journals which provide information on such questions they would not ask how much an imported machine costs compared to a domestic one. At the time of its appearance--as we could read in OTLET and later in MIKROVILAG or could have heard years ago in a TV interview with experts of the KFKI [Central Physics Research Institute]--the HT-1080



computer contained 250 dollars' worth of imported parts while the ZX Spectrum, with three times the RAM and color display possibility, cost about the same.

The French example is interesting, but we would have to add that in a number of areas France devotes sizable sums (that is takes an economic loss) to remain in the front bunch in scientific, technical, cultural and political areas (for example, it has an independent nuclear military force). But I do not believe that we should learn from the French in every field. There is also the German Federal Republic. A superficial glance shows that there is no West German machine in the cheap hobby computer category. Siemens and other firms--surveying the chances--either did not step into the ring or got out in time. And if they give themselves no chance on this market what chance could domestic manufacturers have?

In any case, Hungarian computer manufacture is characterized by the principle "do it yourself." It is thought provoking that even a successful enterprise like IBM prepared its PC operating system with "outsiders" although it has nearly as many programmers as in all of Hungary. Such a thing is almost unimaginable here. We scatter and waste the sparse resources (and this is more applicable to intellectual resources than material ones) to develop unmarketable machines which are compatible with nothing and programs fitting a single user. We prepare networks where it is impossible to telephone and the network power is good if it is 200 volts (because power failures are not rare). We manufacture printers while our printing industry is incapable of producing properly perforated fanfold paper. Well, in my opinion those are right who take the "build it yourself" path and manufacture (assemble) IBM compatible machines.

As for the C-16 and Plus 4 machines used in the schools, they are not cheap for the reason laymen and the manufacturers of Hungarian competing products might think or because of their 8,000 forint price but rather, primarily, because they are reliable, take hard wear and have a relatively long life expectancy. Even a 16 bit computer costing 1,000 forints can be expensive if it has to be serviced twice a month, and in the good case the nearest service center is 50 kilometers away at the county seat.

Finally, in the sense of Hume's law, it is clear that Hungary should export certain things and import others, even in the extreme (rather theoretical) case that we manufacture everything less economically, without exception, than a country more developed than we. But it is also certain that it is not worth it for us to manufacture computers. And, finally, what is worth while here is goose liver or keys for computer keyboards and winter salami or software, although one might argue about that. I would give up complex computer manufacture. Still I would be very happy if I had to submit a "correction" to this journal in 1990 because my prediction was not fulfilled.

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CSO: 2502/65

## IBM COPICS SYSTEM AT MAJOR HUNGARIAN RAIL CAR, MACHINE FACTORY

Budapest COMPUTERWORLD/SZAMITASTECHNIKA in Hungarian No 8, 22 Apr 87 p 19

[Article by Janos Andor Vertes: "A Historic Moment"]

[Text] The Raba Hungarian Car and Machine Factory does not boast a commanding gateway or hyper-super office building. At the main entrance, where among the many illegally parked cars there is also a dusty red Opel with an A license plate, a guest looks around somewhat sceptically: Did the general staff of General Motors come and go through this underpass gate? The faces of the people blend into the environment--tired-gray uniformity everywhere. "There's a big drive on," they say, if they permit themselves enough relaxation to say anything. Since the dusty red carpet is unrolled for the guest here also in the form of reporting in on the telephone the administrators waiting for the line had only a few seconds to complain. Without asking it turns out that anyone who does not submit his secondary school certificate by the time limits can put on his cap--however much man-killing time he spent in the factory.

At Raba the external appearance of the gate, the mood of the administrative staff and the condition of the office building do not appear to be cardinal questions. These are the necessary concomitants of production, tools in their place, which are obviously subordinated to the physical work. It is on the production lines at Raba that one must seek the esthetic, the elegance, the satisfaction. The uniforms of the workers are spotlessly clean. The order in the instrument industry could not be different. At Raba--and after this there is no need to explain it--the chief task of the several million dollar computer inventory is not to simplify or facilitate administration or management.

SZAMITASTECHNIKA reported on the new computers at Raba a year ago. The sizes are imposing--four large IBM 4361 computers, eight System/36 minicomputers. At the Gyor sites about 350 picture screen terminals are connected to one or another of the large computers and at the sites outside Gyor another 100 terminals are connected to the System/36 minis. In addition there are at least two dozen professional personal computers, including multi-workstation systems, and these in turn are connected into a network.

Significant hardware, and significant software on it, the so-called COPICS system of IBM. The breakdown of the acronym betrays the character of the

program package--Communication Oriented Production Information Control System. This is a program package developed for manufacturing and assembly enterprises which works on a large computer net and helps to monitor and control the process of material transformation.

Obviously starting up COPICS starts with loading the databank of the system. Thanks to the technical basic data registry module one can access a databank containing the structure, the so-called parts list, of all products; the capacity file, or data on machines and jobs; and a description of manufacturing operations. It may illustrate the order of magnitude that a hundred designers and a hundred manufacturing planners query and maintain the database through 40 terminals.

The second module adapted was inventory records; with its aid one can track purchased reserves in a hundred warehouses, up-to-date (online). (Naturally one could not ask an American program to meet the Hungarian accounting expectations so the necessary tables are prepared with programs they developed themselves with batched processing once a month.)

Daily production data have been monitored since last summer at item and various aggregate levels. It is worth adding another datum to the adaptation of this module: Each month they make 30,000 types of items at Raba and they have to track their degree of completion, quantity and location with the computer.

From the viewpoint of the others the three modules mentioned are the key modules; if the data put into the computer deviate from fact in any respect then the entire needs planning subsystem which tracks this fails. (This is what production control is like. In our editorial article on page 8 which tries to summarize the pessimistic experiences in optimum calculation we mentioned a technical diagnostics station from which the "little finger" data go to the computer center. There can still be human intervention there if the computer wants to scrap a new truck and send the wreck to be sold. At Raba it would cause simply indescribable chaos at 15 levels of a truck manufacturing process if the warehouse reserves and volume in manufacture were not in harmony, if needs planning were to get upset due to faulty data.)

Three, two, one, zero. The moment when they dare to start the needs planning part of the program has arrived at Gyor. In a broader sense of time every sign indicates that by the time this article appears the module will be started up, but it may also take one or two months. This is no small matter; where this module works well one can say that a computer really does control production, the computer will say how much must be manufactured out of what and when.

I did not seem to detect signs of euphoria in the leader of the Raba computer technology empire, Tamas Biborka, when he reached this point in his summary. Probably he bears the difficulties, the starts and stops, of introducing it just as impassively as he does the unbearable noise of the heavily trafficked road below the window of his office. Out of the entire conversation I detected perhaps only one word more stressed than the others, so let it be the last word of this report: "When the planning system gets started we will essentially have solved also the keeping of records on what we produce ourselves, but let me emphasize that this is not a goal, it is a tool!"

## HUNGARY: GRAPHICS MINI: VT-32

Budapest COMPUTERWORLD/SZAMITASTECHNIKA in Hungarian No 8, 22 Apr 87 p 23

[Article by Marton Vargha: "A Hungarian Graphics Minicomputer: The VT-32"]

[Text] The ice finally broke this year at Videoton--they are starting large-scale manufacture of the VT-32 which could be seen for years at the Budapest International Fair.

This computer in the mini category will somewhat end the one-sidedness of the domestic market and may help users to select a modern configuration better fitting the task.

Thanks to a staff at the Videoton Developmental Institute (Vifi) led by Loltan Ujvari and Erzsebet Fenyves this design, more than 3 years old, is still competitive on the swiftly changing computer market. Their basic idea of choosing the VME bus system and UNIX operating system may seem natural looking back, on the basis of the present situation. But these tools spread and became popular just in the last few years.

The successful decision is given special significance by the fact that the effort to standardize is strengthening and a few solutions are coming to dominate on the market.

And the developers of the VT-32 succeeded in choosing so that their machine remains within the sphere defined by the developing standards.

It is true that a customers' market, the demand for systems which can be put together from machines of varied manufacture and for machine-independent user systems is still only a dream in Hungary, but on the world market, within a few years, one who does not meet the strict requirements laid down by the standards can close up shop.

The most important hunting ground of the developers of the VT-32 is computer graphics. The graphics work station, supplied with a fast graphics processor and a display providing suitable resolution, is virtually unique in the CEMA countries. The PixMan (Pixel Manager) microprogram system supports window management, GKS (Graphical Kernel System) and the CGI (Copy Graphic Interface) ISO recommendation.



Supplied with user programs the VT-32, equipped with mouse and bitpad (tablet), can be a suitable engineering designing tool. This ability--in accordance with the undisguised intention of Videoton--could play a key role in the ever more urgent domestic spread of CAD.

Speaking of user programs the question immediately arises as to how many such program systems which will work on the VT-32 can be obtained here, in Hungary and in the CEMA countries. One certainly can, the pipe network designing system, PIPEMATIC, of the Finnish firm called the Elomatic Group.

The tangled lines which can be seen in the photographs were produced with this program by the people at Vifi, naturally in color.

This three-dimensional program system, written in the C language, is used throughout Europe to design pipe networks in designing power plants, chemical industry installations and even refrigerator cars. It is difficult for a human to imagine and design a network of pipes carrying many sorts of materials here and there so as not to discover at the time of construction that two pipes cross one another at a bad place or that a different pipe goes in on one side of the wall from what comes out on the other. Such mistakes can be avoided with computerized designing.

As can be seen in the pictures PIPEMATIC prepares front, side and top views and isometric perspectives of the network being designed. It is capable of emphasizing and enlarging designated details and of compiling a pipe network from previously defined elements--a set of shapes. It prints out the finished plan and provides a list of the elements to be built in.

Videoton and the Elomatic Group want to sell jointly in the CEMA countries this CAD program system and the VT-32 graphics work station.

At the KFKI [Central Physics Research Institute] they are developing the AULA integrated circuit designing system for the VT-32 and at the SZKI [Computer Technology Research Institute and Innovation Center] they are developing the ECAD wiring designing system for it.

Although the VT-32 computers are already used--for development--in many places--the Soviet Union, GDR and Finland in addition to Hungary--most of them operate at the Vifi. So far they have connected 10 machines to the Ethernet compatible network which can be seen in the figure. These are put together in various ways. They include graphic work stations, a large capacity magnetic disk store control, network control and a machine with a large capacity printer for documentation purposes.

Videoton counts on making one hundred VT-32 computers this year. Compared with the market for professional personal computers this is an insignificant number but it could be a good foundation for further development and for slowing the lag behind the world market.

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CSO: 2502/65

## HUNGARY: COMPUTER ENGINEERS AT HYDROCARBON RESEARCH INSTITUTE

Budapest COMPUTERWORLD/SZAMITASTECHNIKA in Hungarian No 8, 22 Apr 87 p 24

[Article by Gitta Takacs: "Computer Engineers--In a Matrix Organization"]

[Text] How does the introduction of computer technology begin at our enterprises and plants? Let us say it does so with creation of a computer technology and organization department. But what are we to think of an institute which formed and then quickly abolished this computer technology department?

This is what happened a few years ago at the Hungarian Hydrocarbon Research and Development Institute (SZKFI), at the recommendation of managing director Janos Pakucs, a recommendation not received with unanimous enthusiasm at the time but one which experience has proven good since. The computer engineers were scattered to the most varied main departments of the institute. You might say that they were built in as "matrix elements" into the institutional organization which operates at nine sites with 18 self-accounting units in various parts of the country--for example, Budapest, Szazhalombatta, Szeged, Szolnok and Nagykanizsa.

There is a TPA-1148 computer in Budapest, they work with a similar one in Szazhalombatta, with a TPA-1140 in Nagykanizsa and with an EMU-11 minicomputer in Szeged and Szolnok. Two computers work together in a network with NEDIX lines. For the time being only a few of the many personal computers used at the SZKFI are connected to the network. In 1980, when the Bekasmegyer computer center was put into operation, the TPA-1140 was still a modern machine; it is in vain that they have since expanded it into a 48, they lack graphics peripherals and plotter and the present 160 megabyte background storage capacity should be five or ten times that. In a word, they have "outgrown" the computer. This fact is felt especially when at peak times many use the programs simultaneously and the response times increase greatly.

Two types of work are done on computer--the programs aiding solution of scientific research and development work and the programs serving institute management. According to Peter Lelkes, computer consultant, professional guide for the "matrix" of computer specialists and author of the great majority of the mathematical statistics programs: "From the programming viewpoint there is not much difference between writing programs to aid scientific work and

writing management systems. In both areas we solve in a similar way the data input, data management and development of a central database and of the data files belonging to the various classes. And the systems are similar too in that we put friendly programs into the hands of the workers. The researchers handle the computer as if they were perusing their usual indexed pamphlets while the management workers, as it were, handle cards, lists and forms. Every instruction can be put into the machine in Hungarian, one has to learn only one or two commands, otherwise the menu system guides the hand of the user."

The mathematical statistics program package aiding scientific work now consists of about 120 programs and it is constantly expanding. The programs, written in FORTRAN, do correlation calculations, factor analysis, cluster analysis and statistical tests. The algorithms, naturally, conform to the peculiarities of hydrocarbon industry research. In many cases they worked up methods from the foreign technical literature and supplemented them with the cooperation of computer specialists and expert researchers. They do not want to sell this program package, embodying great intellectual value, but they will lease it, or rather undertake the solution of analytical tasks on order for institutions working in similar fields, for example the Hungarian State Geological Institute.

The computer people at the institute are not specialized; there are no separate system organizers, process organizers or programmers. Everyone solves the computerizable tasks coming up in his own department.

Zoltan Havasi, the computer specialist for the labor affairs department, says: "We switched from batched processing to the interactive mode 5 years ago, so there is no parallel processing. Today programs have been prepared for every sub-task--for the most varied record keeping, payroll accounting, flexible work time accounting, supplementary allowances accounting, etc. Now we are working on expanding and refining the programs, for which the workers in the labor affairs department provide ideas. Every program has someone responsible for it, the data patron, who "bears its troubles." Their ages are between 20 and 50 years. When we introduced the interactive programs we provided all sorts of game programs to go with them--to teach use of the keyboard and how to read the screen. The only point where there were problems was querying the database, when one must orient oneself among the and/or logical connections; the possibility of data selection according to many sorts of factors required a new way of thinking.

"The subsystems work independently but in part they use a common labor affairs database. We were careful to store each datum in the system only one time. It is also important that we immediately build into the programs the changes prescribed in labor affairs and wage management rules--most recently, for example, the modification in reporting obligations for supplementary allowances."

This program system works in two places now. The Construction Industry Supply Enterprise bought it from the SZKFI and is trying to install it on an SZM 4 computer.



But the real measure of the success of the computer people is that in a single day the workers are finished with the monthly payroll accounting and while at other enterprises they scrawl out pay lists the officials here--after having given the proper instructions to the computer--can sit back and have a cup of coffee....

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CSO: 2502/65

## HUNGARY: MISKOLC UNIVERSITY DEVELOPS SOFTWARE FOR VT-32

Budapest COMPUTERWORLD/SZAMITASTECHNIKA in Hungarian No 8, 22 Apr 87 p 23

[Article by Tamas Kolossa: "Natives Keep Out!"]

[Text] Fourteen people in the Machine Elements Faculty of the Heavy Industry Technical University in Miskolc are working on a transmission designing program system called MAID which can run on the VT-32.

Exploiting a two workstation possibility lecturer Peter Scholtz and his colleagues have separated the graphic and alphanumeric tasks. In this way they may have anticipated the appearance of the VT-32; they already put 8 years of work in an alphanumeric program written for the VT-16. Since the latter requires at least 15 megabytes of storage it is understandable that it causes no little headache to tie together the program parts and databases running under MS-DOS and operate them on the VT-32.

The alphanumeric program is written in FORTRAN and the database manager for it is written in the C language. The ten blocks of the designing system, based on the ISO international technical standard, make it possible to build up a kinematic sketch of the transmission as a first step. Using the symbols customary in technical drawings the engineer sitting in front of the screen answers questions, easily selecting among the pictograms appearing in the heading, and can develop in an interactive mode the internal arrangement of the transmission. In the next step the computer again asks questions about the basic data of the transmission being designed--the planned life expectancy, the input rotation direction, power, stress, revolutions per minute, method of being built in, gear ratio, etc. The most appropriate answers can be called from the data field; one can also query tables containing professional literature. This solution is characteristic of the MAID as a whole so after graphics supplementation of the system and getting that into operation we will certainly be able to talk not only of one of the CAD systems but also of an expert system.

The third step, the block supporting pre-design of the cog-wheels, helps in a similar way. In addition to diameter and tooth size data one can select the direction of the tooth cutting with the pictograms. Cog-wheels are connected to axles by some attachment method, and this is the next block. Fiftyfour basic axle and attachment solutions are defined in the pre-plan; if one is

lucky these can be used without change. Then one can design the spatial arrangement, placement of the elements and support for the load bearing parts. The roller bearings here can also be selected from a catalog (building in other types of bearings is now being done). Like every block this also contains a check routine which prevents input of faulty data and thus the use of "natives" or parts which cannot be assembled.

When every element and its placement are known one can shift to strength tests. It is well known that the sharp shoulders of axles are sources of mechanical tension so they have solved not only the display but also the computation of fine rounding down. Flexural oscillation studies of transmissions are needed to precisely establish the safety factors. After detailed strength tests of the cog-wheels they do the i--tribological design, that is working out the internal lubrication of the transmission (oil, grease, friction coefficients, etc.).

One can see that each block is a miniature CAD system. It is not by chance that the designers built a structure and system for the data obtained as a result so that they can be used directly as input data for a numerically controlled manufacturing machine. In addition, the flexibility of the strength plans makes some simulation possible.

According to the plans the MAID system will be put to work on a VT-32 in the near future. It will then be tested in use at Rekard in Gyor. With the two and three-dimensional graphics programs to be attached to it we may be witnesses to the birth of a product unparalleled in its field.

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CSO: 2502/65

## HUNGARY: FACTS ABOUT INCOME, PROFITS, COSTS OF TYPICAL SMALL COOPERATIVE

Budapest COMPUTERWORLD/SZAMITASTECHNIKA in Hungarian No 9, 6 May 87 p 9

[Article by Janos Andor Vertes: "A Balance on the Balance"]

[Text] Experts, and even lay people, are debating more and more about small cooperatives--as a form of undertaking, management and production. Legends are born about the earning possibilities, stories circulate about fabulous growth, rumors are spread about impending changes in regulations which would end the "exceptional" treatment, conduct of business and taxation. It would be good sometimes to look at the facts instead of the legends, stories and rumors, but the small cooperatives treat the obtainable information primly and the supervisory organs treat the expected regulation changes as state secrets and so the foggy guesswork remains. If only....

Well, there is a small cooperative whose president felt that they had nothing to hide. Our journal received for its free use the balances which the leadership showed to the members, without change. We can make public the income, sales receipts and costs and we can analyze the numbers as we like. The sample is small, it involves just one small cooperative, but at least it is concrete. The lessons however--and this is why we are taking advantage of the possibility--are most general.

## Characteristics of the Main Body

Szamszov [the Computer Technology Small Cooperative] is not first in the ranks of the small computer technology undertakings (not in regard to when it was formed or in sales receipts or in number of personnel) but neither is it last. In their ads they proudly claim to be a member of the PerComp association, since PerComp--after its success in the OMFEB [National Technical Development Committee] competition--bears the stamp of a cooperative industry recognized by the state. It is a leader in those things which characterize the main body of similar undertakings.

What are these?

In the first half of the 1980's a few experts around thirty years old felt that the OFFICE was not the optimal arena for the development of their knowledge, talent and training, for suitable rewards for the work done or for

the responsible material and moral assumption of independent creation. (You say the phenomenon is not unique?)

Sixteen of them formed a small cooperative.

(One needs 15 people to form a small cooperative and what is necessary is almost always sufficient, for where is their a group of friends larger than this?)

They regarded software development as their basic activity but they quickly recognized that when designing user systems it was frequently necessary to design elements of the hardware too, and that acquisition and turn-key delivery were activities bringing profit.

(Ninetynine percent of the small undertakings start in the direction of software, requiring no capital investment, but if they do not immediately eat up the profit they get into hardware trade by investing it.)

The original older members wait at the university gate for the fresh graduates to renew the cooperative personnel with the best of them; the experience which is well acquainted with walls and limits melds with creativity which knows no walls or limits.

(The recognized optimum is that one should be over thirty to organize, under thirty to program.)

#### Let Us Compute Together!

After so many typical aspects the concrete facts are reassuring. It follows logically from what has been said that the figures are valid for the larger part of the main body. Let us look at the development (in thousands of forints) of the sales receipts and costs of the Szamszov small cooperative in the 3 years since it was formed on 18 April 1984:

	1984	1985	1986
	----	----	----
Total sales receipts	6,261	36,148	185,515
Wages during the year (without bonuses)	1,225	6,074	7,199
Total costs	4,755	31,296	171,252
Balance profit	1,506	4,852	14,263
To maintain cooperative	41	139	242
Income tax	956	3,775	8,156
Year-end shares	--	--	1,900
Leaders' premiums	--	--	126

A few other data for 1986 are: payment to the social insurance contribution, 2.53 million; use for developmental purposes of the fund available at the end of the year, 3.7 million; and sales receipts per capita, 4.9 million.

In accordance with the good, old Hungarian custom the first thing everyone would like to get from the table is, How much can one earn? The calculation is

simple: We divide the 1.22 million forints in 1984 by the number of workers (full-time and part-time, members and employees) and by the 8.5 months of operation, and out comes the exorbitant pay of about 4,000 forints. Some may break out in tears but they did not feel sorry for themselves because they knew what was happening and that within 2 years they had to return the investment. Let us jump to 1986. If we divide the 7.2 million paid out during the year by the personnel who got it then we get 112,946 forints per capita, which is net income. If we add the year-end shares we get an average monthly income of 12,200 forints. The full-time members did better; the 17 of them got 130,176 forints during the year, their income for the year is 206,182 forints, which is somewhat more than 17,000 per month.

Not a bad income. Computer technicians working in an office or an enterprise can get this much only by also working in a VGMK [enterprise economic work association] or GMK [economic work association]; in a cooperative the two types of work time merge together. But however pleasing this figure is it would be an exaggeration to call this pay legendary (in the case of graduate, experienced experts going on forty). Other sums fly on the wings of rumor.

It is possible, of course, that one should not look at the averages even within a single small cooperative, but rather at the concrete figures there also. So what was the minimal and maximal income and what was the spread? Well the lower limit in 1986 was 102,000 and the upper was 280,000. As one can see, they differentiate boldly, but the peak is 23,000 forints per month, and even that is this side of legendary. Especially if we now generate a 3 year average out of the annual averages, if we balance the present prosperity by the initial difficulties.

#### The Other Pan of the Balance

Of course, legislators and officials responsible for financial matters do not relate present buying power to the day before yesterday but rather to the goods produced today. So let us compare it to this. At Szamszov there is 5.61 forints of material-free production value for every forint of income during the year. Of this production they pay 1.50 forints into the budget, that is one and half times as much as the worker gets in hand. Hmm, however we look at it there is no need to fear an unfounded outflow of wages. Indeed, it appears that these small cooperatives are thinking about tomorrow and although regulations do not stipulate how much they must put into the various funds they are significantly increasing their common property. Szamszov started with 255,000 forints of property; at the end of 1986 they had 8,728,000 forints worth and 1987 began with additional investment. The increase is 3,422 percent!

So unlimited income is not at all identical with dishonestly high income (with an increase in buying power for which there is no goods base or with income obtained without work). And it is precisely development free from limits which is the only possibility for a managing organization to multiply its production year after year. It is probable that the second 3 years will not bring such growth as the first 3 years, not at Szamszov or at any small cooperative. Nature itself--unless someone gets a truly new idea--poses limits. But this natural braking effect is entirely different from planning with a base line



attitude. Today, when we talk about the necessity of a structural transformation of the economy, it is essential that there be on an ever broader scale managing organizations where there are no external limits to performance and effectiveness.

The Given Word and Taxes [Note: "Tax" and "giver" are the same word in Hungarian.]

We are on the threshold of tax reform. Hopefully our financial regulators, now being worked out, will not develop in such a way that--due to what is called the political public mood--limited wages and, what accompanies it, limited development will get broader (or even exclusive) scope to the detriment of free growth. If these stray rumors should have some truth content then our fundamental economic policy goals would be endangered and the words spoken by Minister of Industry Laszlo Kopolyi at the end of last year at the ninth cooperative congress would appear to be futile: "By virtue of a flexible production policy the industrial cooperatives are evolving market building strategic possibilities which make it possible for their activity to be dynamic and quickly developing even amidst generally narrowing, generally worsening market possibilities."

In a general way Szamszov is among the concrete small cooperatives. They were the first to move into the "Silicon Valley" along the Danube, into the one-time house factory area of the 43rd AEV [State Construction Enterprise], because they believed that industrial policy "would like to support itself on the technical development activity, already famous beyond the borders of the country, taking place in the cooperatives, as partners of equal rank with the university, science and the foci of industrial development." (In this case also, naturally, the words come from the minister of industry.) They are making moderate plans--sales receipts of 250 million for 1987, 300 million for 1988 and 330 million for 1989. This year they would like to double their gross income (the balance result plus wages during the year) compared to last year, but for the next 3 years they plan to put into the distributable fund (wages during the year plus end-of-year shares) a sum similar to this year, about 10 million. Perhaps precisely because building the future is accompanied by costs and sacrifices and perhaps also because they do not want to crack for the sake of yet higher income but rather to enjoy what they find sufficient. They are even planning the taxes carefully--15 million this year, 19 million next year and 21.6 million after that. As if everything in 1988 and 1989 would be the same as today.

Nor is this a lesson to be underestimated--these few dozen people trust in the given word. And if we put in the place of these few dozen the main body which resembles them in every respect then we are talking about tens of thousands. Tens of thousands who trust in the future!

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CSO: 2502/69

## HUNGARY: LACK OF FUNDS, OBSOLETE TECHNOLOGIES SLOW USE OF CAD/CAM SYSTEMS

Budapest FIGYELO in Hungarian No 23, 4 Jun-87 pp 1, 4

[Unsigned article: "High C Techniques"]

[Text] "The proof of the pudding is the simulation," was the new version of the old saying voiced at the Ministry of Industry professional day on computer aided engineering design, or CAD to use the English language initials, held for leaders of industrial enterprises.

The use of CAD is changing engineering work and the designing process. Sitting before the screen of a computer the designer can try out many variations of his ideas with a few keys--or other auxiliary tools. He can view and study the planned part from every side, can simulate its behavior under various physical effects--heat, pressure--or can change color and shape features and so forth. The next step is to have the dreamed of product created by a computerized manufacturing system, possibly untouched by human hands. (This is CAM, computer aided manufacturing, or CIM, computer integrated manufacturing.) But, of course, not in Hungary, for these "C" techniques are found in our industrial practice only in traces so far.

But the first notable domestic achievements in this area were born during the Fifth 5-Year Plan when they created at the Telecommunications Research Institute a system suitable for designing printed circuit sheets. At the time it was in the front rank internationally. Indeed, a research and development society was formed from a few electronics enterprises which used the system. The lessons and the results of the further development of the system survive today; they succeeded in introducing and spreading standardized, uniform designing elements which was not possible earlier with any sort of economic prescription or administrative regulation--without the constraint of an electronic designing system. During the Sixth 5-Year Plan--when the domestic microelectronics industry was being created--there was no other possibility for engineering work in this special area, only the use of CAD. They also experimented with a few machine industry-mechanical designing systems--primarily at MTA SZTAKI [Computer Technology and Automation Research Institute of the Hungarian Academy of Sciences]--and created one or two user systems in industry--generally from imported equipment.

But the domestic spread of CAD/CAM is slow. In addition to the lack of money which can be used to purchase equipment and the well known trade restrictions a number of other factors make it difficult. For example, there are few well prepared, highly qualified experts; training has to prepare the engineers and technicians first. The present situation is--as a designer for one of our machine industry enterprises said at a roundtable discussion at FIGYELO (No 13, 1987)--that it is good if a few percent of the engineers at a large enterprise understand these methods, which mean something fundamentally new and demand a new attitude and designing behavior.

The technologies used in industry have become obsolete, to such an extent that most of them "do not merit" CAD/CAM methods. If the modernness of the technology and the degree of enterprise organization do not reach a certain level then the introduction of CAD/CAM would hurt more than it would improve the situation. But it is also true that even the forced inclusion of computerized designing-manufacturing methods in an organization or production process can have a good effect on the degree of organization and the quality of professional work, draws good designers to the enterprise, etc. According to the experts the enterprises in Hungarian industry in the energy production, vehicle industry, machine tool and chemical industry (petrochemistry, pharmaceuticals, rubber industry) sectors meet the requirements best and they are also planning introduction of CAD/CAM in a few light industry plants (shoe, textile clothing and furniture manufacturing).

Domestic research and development achievements--e.g., at MTA SZTAKI and the BME [Budapest Technical University]--in the area of technologization and design are outstanding even internationally. But the interest of professional scientific circles has not been accompanied by the creation of suitable domestic reference applications. Most of the developments have not yet been tested in an industrial series. But still a few computerized parts manufacturing systems are in operation, for example at Ikarus, Ganz-MAVAG, the Ganz Danubius Ship and Crane Factory, the EMG [Electronic Measuring Instruments Factory] and Videoton.

#### A Federation

A realistic approach to strengthening receptivity--the "human factor" and the technical conditions--and to introduce and spread CAD/CAM might be the creation of so-called model systems or reference systems, bringing the sparse intellectual and material resources together.

In March a founding contract was signed for a Manufacturing Automation Research and Development Society created, after months of preparatory, harmonizing discussions organized by the minister of industry, by eight institutions belonging to various ministries and chief authorities. The Ministry of Industry, the Budapest Technical University, MTA SZTAKI, the Central Physics Research Institute, the Technova Industrial Development Bank, Videoton, the Computer Technology Applications Enterprise and the Csépel Works Industrial Center (the G/6 program office) joined together to develop computerized designing-manufacturing model systems for research and production purposes, also bringing direct industrial profit, and meeting international standards. It will try out hardware and software acquired from abroad, judge

domestically developed achievements, undertake "technical management" tasks when industrial CAD/CAM systems are set up, organize the training connected with this, etc. According to preliminary contracts recently signed the Ministry of Industry will finance the tools for two model systems out of the central technical development fund. They are giving 81.5 million forints in support for a CAD/CAM system to be set up at the Budapest Technical University and 60.5 million for a system to be developed in the Kende Street building of MTA SZTAKI. After completion of the R&D investment, which has no repayment obligation, the tools will become the property of SZTAKI and the BME. According to the agreement the members of the association are obliged to give priority to the orders of industrial enterprises, and a definite percent of the income from sale of the software development results must be paid into the central technical development fund of the Ministry of Industry.

### Three Hundred Entries

The "foundation stones" of peak technologies can be laid most cheaply at these two institutions because some of the necessary mechanical and computer technology tools are already available and in addition they can bear here the "pains" going with development of the "C" techniques better than in some industrial plant operating "live." And since quite a few devoted experts are also needed to set up the "C tests" it was certainly not an incidental factor in the decision that the domestic "mechatronics revolution" started from the machine manufacturing faculty of the BME and the workshops of SZTAKI.... The industrial utilization of the already mentioned research and development achievements, achieved primarily in the area of machine industry automation and regarded as outstanding even internationally, will also be aided by an international joint stock company formed under the name Flexys which joins MTA SZTAKI, the State Development Bank and the Oesterreichische Landbank to the name of the TRANSMERX subsidiary. (See our article titled "Flexys Co.")

Perhaps the greatest hope for reducing our backwardness in the "C" techniques is given by the G/6 program of the OKKFT [National Medium-Range Research and Development Plan], started with the title "R&D Tasks of Manufacturing Automation, Electronic Devices Connected with Precision Engineering and Their Production," under the guidance of the Ministry of Industry. Its role will be a determining one in the burningly necessary transformation of the machine industry product and production structure. (The G/6 program is being coordinated with the G/1 electrification OKKFT program cared for by the OMFB [National Technical Development Committee] and with the ministry level programs of the OMFB and the Ministry of Industry.)

The theme of computerized design and manufacturing systems figured in research and development programs earlier too but the total of the funds which could be turned to this purpose never reached the "critical mass" and there were many human, professional and financial standstills. Even the G/6 program, after many years of gestation, obtuseness and preamble, got started again at last with a delay of about 10 years. (FIGYELO, No 51-52, 1986.)

The domestic managing organizations received the G/6 program with very great interest and special expectation. Within two months 263 entries arrived for the competition announced last summer and their number since has exceeded 300.



For example, Ikarus undertook to create an integrated, computer supported tool designing and manufacturing model system; the Csepel Works Machine Tool Factory will create a so-called flexible manufacturing system to process complex machine parts; DIGEP [the Diosgyor Machine Factory] is working on development of an automated sheet processing system; the EMG, Vilati and SZTAKI are jointly developing a new generation of machine tool, robot and system controls which can be built into computerized manufacturing systems.

But unfortunately one can also read from the competition entries the difficulties and negative aspects of the domestic industrial and research environment. A good number of the entries did not define a research and development goal but only asked for state support for technological modernization. There were also few entries planning acquisition and adaption of licenses and know-how. There was no real industrial need behind some of the plans coming from research sites and it was not clear if there would be a manufacturer or user for the device to be made. Nor was a sufficient result brought by the effort of those guiding G/6 to have enterprises and research sites compete jointly for the development of some theme in the interest of market success.

#### To Develop, But From What?

In the final analysis the successful implementation of the G/6 program also depends on the general domestic economic conditions, which determine the entrepreneurial readiness of the developers, the degree of their contribution to the costs and the solvent demand for the devices made. The ability of the enterprises to bear risk is small, it is difficult for them to assume the conditions of credits connected with the program, citing the size of the withdrawals, their unstable economic position and the fact that one cannot achieve an economical series size with domestic market sales and socialist market sales are difficult. The limited investment funds also limit research and development undertakings. In the G/6 program they are trying to reduce this by making it possible to finance certain technological modernization investments, such as putting CAD/CAM systems into operation, out of the technical development fund--in accordance with Ministry of Finance decree 36/1986 PM.

But the enterprises--lacking information and adequate descriptions of the regulations--do not always know the concessions which can be obtained or how to make use of them. (For example, they used only half of the allotment provided last year for duty concessions on certain electronic and robotic equipment.)

The cost prescription for the G/6 program for 5 years is 6.38 billion forints; 2.1 billion forints of this will come from the central technical development fund, every quarter the Ministry of Industry transfers the time proportional part of this to an account of the Technova Industrial Development Bank which handles the G/6 finances; the budget will provide 400 million forints (for the time being, however, this source cannot be mobilized); the contribution expected from the enterprises is 3.8 billion forints.

The cost of a single CAD/CAM developmental task is between 6 and 100 million forints and the time for realization is 2-3 years. But this could be greatly prolonged if acquisition of parts, high precision manufacturing tools, etc. is delayed--generally due to a lack of capitalist foreign exchange. Last year there was no G/6 foreign exchange at all. The G/6 is an expressly peak technology program; its tasks cannot be solved with the existing obsolete equipment of the institutions. And the real value of the expenditures--unfortunately--decreases year by year due to environmental effects, price increases and changes in the rate of exchange.

#### Pressed For Time

Around the world development in the "C" techniques is extraordinarily swift. They say that every day at the exhibits and trade fairs they exhibit new designing-manufacturing devices with new dazzling, brilliant technology, but what they really can do is known only months after the purchase. The price of software is increasing swiftly, and comes to 80-90 percent of the price of the system.

An expert at Videoton mentioned the Finnish example of use of CAD. Using traditional methods an engineer designed one meter of a pipe system in 2-3 hours. When computer software was introduced the same thing took 5 hours. After one and a half or two years (!) of designing experience the necessary time fell to 30 minutes.

The simple example can be generalized too. One cannot expect immediate results from CAD/CAM experiments or industrial tests. One can count on economic profit beginning in 1988 at the earliest, and only where the technical tests started last year, for example at Ikarus and the Csepel Machine Tool Factory.

The technological gap which separates Hungarian industry from the international average grows ever deeper, whether we look at the automation of production or the modernness, quality and reliability of the products manufactured. In addition to the limited material sources the cause of the situation which has developed is also a faulty investment policy which can be attributed to an incorrect attitude and lack of understanding.

The introduction and spread of the "C" techniques have been delayed in the Hungarian industrial world and although we could speak of definite steps even in this article there is little money concentrated for this purpose and we must continue to reckon with many inhibiting circumstances.

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CSO: 2502/70



## HUNGARY: LACK OF FOREIGN EXCHANGE IMPEDES FACTORY AUTOMATION PROGRAM

Budapest COMPUTERWORLD/SZAMITASTECHNIKA in Hungarian No 9, 6 May 87 p 4

[Article by G. T.: "The 'C' Techniques Program"]

[Text] Peak technology is the soul of every product today, even of an otherwise mediocre quality machine industry product. And for the products of Hungarian industry it is precisely this "soul" which must be purchased--if it can be at all--for foreign exchange. CAD, CAM, CIM and similar acronyms, most of them beginning with C, sum up the techniques and methods indicating the new paths of machine industry manufacture, things hardly yet found in our industrial practice.

The G/6 program of the OKKFT [National Medium-Range Research and Development Plan] started with the title "R and D Tasks of Manufacturing Automation, Electronic Devices Connected With Precision Engineering and Their Production" is an attempt to narrow this technical-technological gap. It will have a determining role in transforming the machine industry product and production structure but the key factor in its implementation is the use of electronics and computer technology. This latter fact justifies our giving a situation report from time to time about the status of the "C" techniques program. (See our issues No 3, 1986, and No 1, 1987.)

We asked Antal Tari, chief of the G/6 program office, for a briefing on the results of the first year of the G/6 for the Seventh 5-Year Plan, on the solution of parts of the task and on factors impeding realization of the goals set forth. (The patron of the program office is the Csepel Works Industrial Center.)

The domestic managing organizations received the G/6 program with great interest and special expectation. This is also proven by the fact that within only 2 months 263 entries arrived for the contest announced last summer; their number now exceeds 300 and the sum of the support requested comes to 10 billion forints. (The prescription for the 5 years of G/6 is 6.38 billion forints.)

Those guiding the program find many entries to be truly high level and promising relatively fast economic results--for example the Ikarus undertaking to create a computer supported, integrated model tool designing and

manufacturing system. The Machine Tool Factory of the Csepel Works will create a flexible manufacturing system to process complex machine parts. Digep [the Diosgyor Machine Factory] has received significant support to develop an automated sheet processing system. The EMG [Electronic Measuring Instruments Factory], Vilati and the MTA SZTAKI [Computer Technology and Automation Research Institute of the Hungarian Academy of Sciences] are jointly developing a new generation of machine tool, robot, cell and system controls to be built into flexible manufacturing systems.

It must be mentioned as a uniquely negative aspect of the entries that a good number of them did not put forth a research and development goal but only asked state support for technological modernization. There were also few proposals planning to organize and introduce scientific information (license, know-how) already existing elsewhere. Some of the entries from research sites were judged thematically valuable but no real industrial need stood behind the research plan and it was not indicated that there would be a manufacturer or user for the device to be made.

The cost of each developmental task judged worthy of support by the G/6 program is between 6 and 100 million forints and the time for realization is expected to be 2-3 years. This could be greatly prolonged, however, if acquisition of parts, subassemblies, measuring devices or high precision manufacturing machines is delayed--generally because of the lack of capitalist foreign exchange. Last year the G/6 simply did not get any foreign exchange and the acquisition of peak technology tools could begin only this year. The G/6 is an expressly peak technology program; its tasks cannot be solved with the existing equipment of industry and research and educational institutions; the purchase of new tools and new procedures is absolutely necessary. And--unfortunately--the real value of the expenditures falls year by year due to environmental effects, price increases and changes in the rate of exchange.

Of the cost prescription for the program a 2.1 billion forint part will come from the central technical development fund; a time proportional part of this is transferred quarterly by the Ministry of Industry to an account at the Technova Industrial Development Bank which handles the G/6 finances. The budget is providing 400 million forints but for the time being this source cannot be mobilized; the possibility of access and the method of handling it and accounting for it are not yet entirely clear. The contribution expected from the enterprises is 3.8 billion forints.

Naturally the successful execution of the G/6 program also greatly depends on the general domestic economic conditions, which determine the readiness of potential developers to undertake projects, the size of their own contributions to the budgets and the solvent demand for the developmental results. The limited nature of investment funds is a problem people are bored hearing about but it also limits research and development undertakings. They are trying to partially compensate for this in the program by exempting a few technological modernization investments (e.g., putting CAD/CAM systems into operation) from the financial regulation according to which the money turned to this cannot be accounted for in the "R and D" rubric.

The ability of the enterprises to bear risk is small, they are reluctant to undertake the conditions for the credits connected with the program, citing the size of the withdrawals, their unstable economic position and the fact that with domestic market sales they could not achieve economical series size and that socialist market sales are difficult. Experience also shows that the enterprises--in the absence of suitable descriptions of the regulations and widespread information--do not really know even the concessions which could be obtained or the method of asking for them. (This is also shown by the fact--see issue No 5, 1987, of our journal--that last year they used only half of the allotment provided for duty concessions for some modern technical equipment.)

Despite the numerous inhibiting factors there already are some technical results which can be evaluated (for example at Ikarus and the Machine Tool Factory of the Csepel Works), but one can count on real economic profit beginning in 1988 at the earliest.

The G/6 is divided into five subprograms. In the manufacturing automation and electronic manufacturing systems theme area, in addition to the already mentioned developments of Ikarus, the Machine Tool Factory of the Csepel Works and Digep, the Machine Tool Industry Works has undertaken a great task in developing five axis controlled machines and Mofem has undertaken to create an automated fittings manufacturing line. The robotics subprogram is based fundamentally on purchase of Japanese (Daido--Csepel Works Custom Machine Factory) and Austrian (IGM--Rekard) licenses and know-how. The Csepel Works Custom Machine Factory and its subcontractors also want to make the hot plant loading robot suitable for castings preparation. Rekard, with Austrian cooperation, is manufacturing an arc welding robot and has set up model systems in its own factory, at the Kecskemet Agricultural Machine Factory, the Veszprem Coal Mines and the Crushing Machine Factory. In the precision engineering subprogram the Labor MIM [Laboratory Instrument Industry Works] is making laboratory scales--among other things. In the machine industry automated technical designing theme area the Industrial Technology Institute is developing, for IBM PC/XT and AT computers, modules to plan the sequence of operations for bodies of rotation, to program drilling and milling machine operations and to optimize the metal cutting parameters. The educational subprogram is of special significance for according to our information this is the first time that a large sum in an industrial R and D program has been designated for educational tasks, the training of industrial experts and creating receptivity for peak technologies. The educational institutions need this primarily for modern tools; in the signed contracts the ratio of money granted for purchase of machines, equipment, software, etc. is about 85 percent.

#### Contracts

As of the middle of March the G/6 program office had signed 64 research and development contracts. We summarize the data on a few of these contracts--those supported by larger sums or aimed at especially important technical-economic goals.

Theme of Contract	Institution Undertaking or Coordinating it	Value of Contract (millions of forints)	Of this, Central Technical Development Fund
Tool designing and manufacturing system	Ikarus	202.00	89.00
Flexible manufacturing system based on MK 500 type machine tool	Csepel Works Machine Tool Factory	109.00	74.00
MCP 1600 manufacturing cell	Machine Tool Industry Works	165.00	38.50
Automated sheet processing system	Digep	120.00	60.00
Development of sensors and cell controls	MTA SZTAKI	8.60	6.50
Development of high precision technology	Mofem	385.50	48.00
Tools for manufacturing cells and flexible manufacturing systems	Forcon [Cutting Tool Industry Enterprise]	92.70	34.60
Purchase of license and know-how for IC assembly system	Tungsram	131.00	43.00
Interrobot	Tungsram	3.30	3.30
Preparing for series manufacture of Rekard RT 280 robot	Rekard	218.70	19.00
Arc welding of safety shields with robots	Veszprem Coal Mines	48.00	10.00
Robot control equipment	Tungsram	57.40	24.50
Electronic laboratory scales	Labor MIM	83.00	32.00
Computerized control of parts manufacture	ITI	92.00	46.00
Conversational graphics CAD system	Comporgan	14.00	7.00
CAD system to design manufacturing tools and CNC controls	FEG [Weapons and Gas Equipment Factory]	92.00	35.00
CAD/CAM model system	Budapest Technical University	81.50	81.50
CAD/CAM model system	MTA SZTAKI	60.50	60.50
Robot technology training	Budapest Tech. U.	364.00	160.00
Robot technology training	Heavy Industry Tech. Univ., Miskolc	180.00	80.00
Manufacturing automation training	Donat Banki Machine Industry Tech. College	9.90	4.90
CAD training	Donat Banki etc.	30.00	15.00
NC, CNC tech. training	Anyos Jedlik Tech. Secondary School	3.74	2.00

Theme of Contract	Institution Undertaking or Coordinating it	Value of Contract (millions of forints)	Of this, Central Technical Development Fund
NC, CNC tech. training	Andras Mechwart Tech. Second. S.	6.10	2.00
NC, CNC tech. training	Ferenc Bajaki Tech. Secondary School	3.35	2.00

The "Balance" of the G/6 Program (in millions of forints)

	Total	Of This:		Budget
		Central Technical Development Fund	Enterprise Sources	
Planned Total	6,380	2,100	3,880	400
Value of contracts signed as of 15 March 1987	3,034	1,174	1,337	8

(and 515 credit)

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CSO: 2502/69



## HUNGARY: FACTORY AUTOMATION R&amp;D ASSOCIATION ESTABLISHED

Budapest COMPUTERWORLD/SZAMITASTECHNIKA in Hungarian No 9, 6 May 87 p 26

[Article by Gitta Takacs: "CAD/CAM Federation"]

[Text] From the viewpoint of the development of domestic industry--especially our machine industry--extraordinary significance can be attributed to the federation which has been put together by eight institutions belonging to various ministries and chief authorities after months of preparatory and harmonizing discussions organized and led by the minister of industry. The name of the new association is the Manufacturing Automation Research and Development Society and its members are the Ministry of Industry, the Budapest Technical University (BME), the MTA [Hungarian Academy of Sciences] Computer Technology and Automation Research Institute (SZTAKI), the Central Physics Research Institute, the Technova Industrial Development Bank, Videoton, the Computer Technology Applications Enterprise and the Csepel Works Industrial Center (the G/6 program office).

The association will aid industrial applications of CAD/CAM with the concentrated and coordinated use of domestic resources. It will create developmental and integrated designing-manufacturing model systems for developmental and production purposes, including those bringing direct industrial profit, which are compatible with international standards. It will see to it that the research and development results achieved in the course of operating the model systems are known and used in practice, primarily in industry. In the model systems to be created they will try out and test the domestic developmental results achieved and the hardware and software tools acquired from abroad. The association will make recommendations for industrial applications connected with CAD/CAM systems offering various solutions and will take care of "technical management" tasks when such industrial systems are set up. It will organize the teaching of CAD/CAM methods and create conditions for this.

The members of the association will study available program packages in the CAD/CAM area and if they recommend their use they will create conditions for putting them to work. They will also judge systems developed domestically. On the basis of contracts signed with the customer they will design CAD/CAM systems satisfying the needs of other areas and help put them to use.



Within the framework of the G/6 manufacturing automation OKKFT [National Medium-Range Research and Development Plan] program the Ministry of Industry will use centralized technical development funds to finance hardware and basic software tools for two model systems. According to the preliminary contracts the Budapest Technical University will get 66.5 million forintssupport to purchase equipment and 15 million forints for operating expenses for the CAD/CAM system to be created. The MTA SZTAKI will get 60.5 million forints for the model system to be set up at the Kende Street headquarters. After completion of the investments, which have no return payment obligation, the research and development tools will become the property of the beneficiaries (BME and MTA SZTAKI).

According to the agreement the members of the association are obliged to give priority to the orders of industrial enterprises; in this regard the Ministry of Industry maintains the right to dispose of the assets. A definite percentage of the income coming from sale of software development results must be paid to the central technical development fund of the Ministry of Industry and the account of the G/6 program. The members of the society will inform one another about software development experiences and results and transfer these results to one another within the framework of special contracts. The operators are responsible for the security of programs installed in the model systems. Ownership rights connected with software products--possession, use and disposition--are regulated as part of the membership contract.

Otherwise the society only coordinates; marketing--the receipts therefrom and the profit or loss generated--is the risk of the vending members.

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CSO: 2502/69

## HUNGARY: COMPANY SET UP FOR ROBOT DEVELOPMENT, PLANNING

Budapest COMPUTERWORLD/SZAMITASTECHNIKA in Hungarian No 9, 6 May 87 p 26

[Article by G. T.: "Roboplan is Little, But...?"]

[Text] The Roboplan Robot and Electronics Development, Design and Organization of Manufacturing Deposit Association was formed on 1 January 1986. The members were the Rekard Agricultural and Mechatronics Machine Factory in Gyor and two small banks, the Agricultural Innovation Bank Joint Stock Company and the Construction Industry Innovation Bank Joint Stock Company. The basic capital came to 12 million forints, half from the Gyor factory and half from the banks.

The antecedents to its formation include the fact that in 1985 Rekard purchased from the Austrian IGM firm the license for an arc welding robot, with the right to manufacture it and sell it in Eastern Europe. They also started a production cooperation in which the Austrian firm provides controls in return for mechanical robot subassemblies manufactured by Rekard. They plan to run the size of the series manufactured up to 50 units per year by 1990. The new engineering enterprise, Roboplan, was created for the jobs connected with installation of these robots, customer service and applications consulting--which are absolutely necessary when selling robots--and to discover and organize domestic market manufacturing capacity for various subassemblies and to further develop the license purchased.

So far little is heard even in professional circles about the work of Roboplan. I have never read its name in an advertisement or announcement. So I asked Ferenc Szegedi, the director of the firm headquartered in Budaors, what they worked on in 1986, what profit they closed the year with and how their future plans were developing.

Well, the director would speak only very reservedly about last year's work of Roboplan. They overfulfilled the plan by 30 percent, about one fifth of the 18 million in receipts can be booked in the profit column and the contracts signed for 1987 so far promise a significant overfulfillment--twice that of last year--but all this will require increasing their development-designing capacity.

We also got a very terse listing of the tasks solved, although the reference list should recruit new customers. "We are participating in a reconstruction program for Soviet agricultural machine manufacturing enterprises. We are working on an automatic materials movement system for the Granit grinding wheel factory and on development of a special robot with which the grinding wheels can be lifted from the press machine by vacuum. We are installing welding and machine tool serving robots manufactured by Rekard. We are talking about a further development commission for a processing center to be manufactured at Csepel. And sometimes we design devices, such as a wine pump which replaces capitalist import."

The plans?

"Very much is still unclear regarding robot manufacture and use in Hungary. We are seeking solutions. Roboplan has organized an interest group in which rather small but also technologically developed institutions are allied for robot manufacture. Our partners are MTA SZTAKI [Computer Technology and Automation Research Institute of the Hungarian Academy of Sciences] in regard to software and the Mikromatika and Mechatronika small cooperatives and Trakis in regard to hardware."

So this is all we succeeded in learning. And also that they would like to work in even greater quiet, "under the grass" you might say, until successfully solved tasks and their achievements inform their environment, their potential partners, about their existence.

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CSO: 2502/69

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## On Our Cover

On our cover one can see a machine tool fitted with a VILATI CNC control. UNIMERIC is a universal microprocessor control system which can be further developed in a flexible way with the growth of needs and can be used with little modification in other systems to perform control tasks. Gyorgy Barat describes the structure and operation of the system in his article.

## Control Technology

In our control technology section we introduce two representative examples primarily from the developmental work of VILATI. This enterprise plays a considerable role in the domestic development of control technology. The development and manufacture of a control system based on a microprocessor-microcomputer is emphasized out of its many-sided activity. The works by both Gyorgy Barat and Sandor Honti represent this. We should also mention robot manufacture and manufacture of robot controls. We dealt with this theme in our sixth issue in 1985 in connection with a description of the DAIDO robot controls. Now we want to refer only to the successful domestic adaptation.

## Space Telecommunications

In our space telecommunications section we begin a series of articles by Janos Csernoch. The goal of the editors--when they agreed with the author to publish the series--was to aid orientation with a thematic compilation in this area, which is already attracting general interest. The author, who has long cultivated this special area and who is also an experienced college instructor, will hopefully deal with this theme in a way understandable even for those who have not dealt deeply with the problems of space telecommunications so far. We also want to call attention to the fact that in our seventh issue this year we will deal, as the chief theme, with the domestic status of space telecommunications and with related developments.

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CSO: 2502/66

## HUNGARY: UNIMERIC CNC MACHINE TOOL CONTROLS

Budapest MAGYAR ELEKTRONIKA in Hungarian No 3, 1987 pp 9-16

[Article by Gyorgy Barat: "UNIMERIC CNC Machine Tool Control Equipment"]

[Text] VILATI has been dealing with development and manufacture of machine tool control equipment for 25 years. Today our equipment can be found in virtually every machine factory and we can satisfy the needs of our users at an ever higher level.

## Introduction

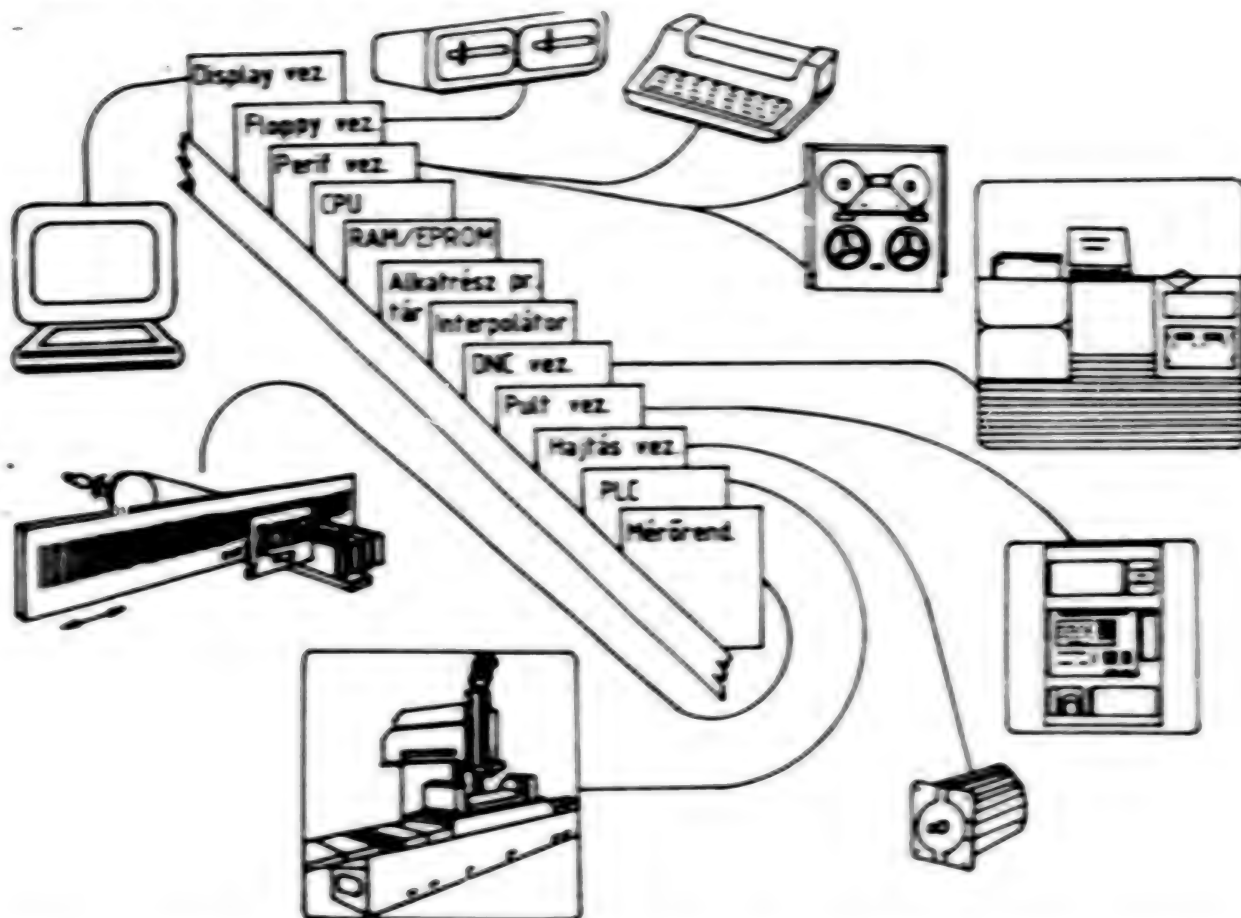
We began development of the UNIMERIC CNC in 1976. The essence of our conception was not to design a special purpose machine but rather a module system from which various types of equipment could be assembled and which would thus be suitable for broad use in industrial automation. We were prompted to this also by a need to better exploit manufacturing capacity, for in this way the elements of our system could be made in larger series. The correctness of our system technology ideas is proven by the fact that we used the same elements to build, in addition to the UNIMERIC CNC, control equipment for the CARTIMAT drawing table (Carl Zeiss Jena), control equipment for astronomical telescopes also made by Zeiss and the UNIPROG microcomputer, which supports mechanization of CNC programming.

We tried to build a system with the aid of general purpose tools under the supervision of a universal microcomputer. So solving the various tasks is primarily a question of program design. Figure 1 shows a block diagram of our system. The elements are connected together by a single bus system, the modules are connected to this; data transmission between modules takes place over it, we do not use any other connection between two modules. Our modules are functionally independent, all are capable of executing some task by themselves, under the supervision of the central unit.

In practice the modular design also means that one card equals one function. We also strictly adhered to the principle of modularity in building our software system, so various versions mean only plugging a card into the rack and compiling the corresponding software system.



Figure 1. Block Diagram of the Module System



[The 12 cards connected to the bus are, from top to bottom: Display control; Floppy control; Peripheral control; CPU; RAM/EPROM; Parts program memory; Interpolator; DNC control; Console control; Drive control; PLC; and Measuring system.]

With a consistent adherence to this simple principle the development of the several modules can take place independent of one another, so in past years we have continually expanded the number of modules which can be used and modernized the elements. In this way the continual development and manufacture hardly caused any difficulties, we were able to follow the market needs and thanks to this we have renewed the system again and again, in its principles unchanged, so that it is modern today.

In early versions of our system we used only one microprocessor. Now we are entrusting more and more tasks to different processors, for example PLC, control of the display, floating point arithmetic and the floppy controller. Thus some modules--subsystems--solve their tasks at an ever higher level, which naturally raises the level of the services of the entire system.

Our solution does not make it possible for us to be competitive in price with the cheapest (low-cost) category CNC equipment; we try to counterbalance this with services which also satisfy the requirements of the most complex processing centers.

## Structure of the Module System

The system is based on one bus; in realizing this we used principles generally widespread in computer technology. We have not built in "extras" for processing, taking the TILINE prescriptions as a base. Unfortunately, contrary to our expectations, TILINE has not spread in a wide sphere. The 16 bit data and 16 bit address and parity protection for both offer a possibility for fast (about 3 megabytes per second) and reliably checked data transmission.

The single card central unit connected to the bus checks and handles the units on one each status register and control register.

It executes the operations connected with this over a separate auxiliary bus on which a 14 bit address and one bit data appear simultaneously again with parity protection. Those units which require only low speed data transmission (1 K byte per second) are connected exclusively to this auxiliary bus.

Sixteen interrupt levels can appear on the bus; initiation of service to each hardware interrupt begins within about 10 microseconds.

The memory modules serve to supplement the central unit; these make possible RAM, CMOSRAM and EPROM expansion in various configurations. "Ramdisks" have been spreading in microcomputer systems recently. We have used such a unit in the UNIMERIC CNC since 1981 to store the parts program, earlier 64 K bytes and now 128 K bytes. This unit does not take up room in the parallel address domain of the system.

Our computer capacity is being expanded. We have designed a unit which contains four hardware arithmetic units (APU), controlled by an auxiliary processor, and 64 K bytes of memory. We use this unit, for example, to solve complex track calculation tasks and also to handle line protocols in a local network. From the central unit this "controller" "appears to be" a RAM area.

We have separate modules to connect computer peripherals and to receive analog output and measurement transmitters.

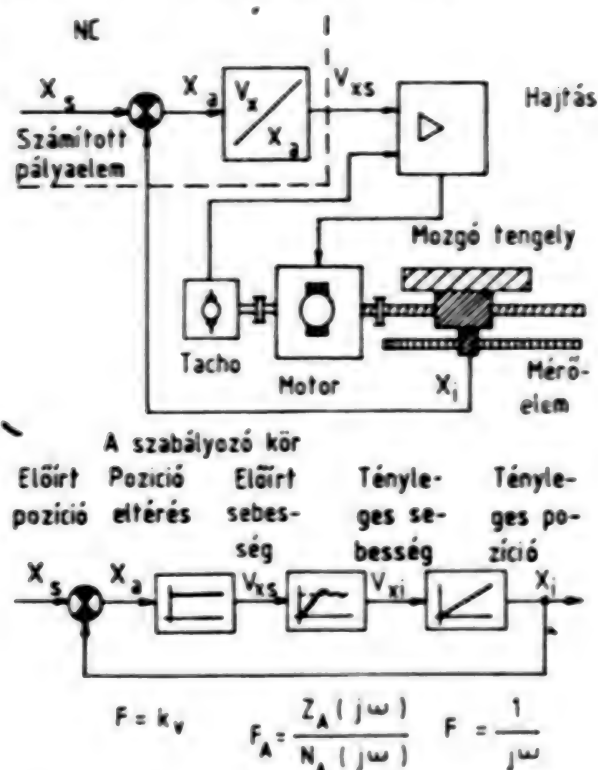
## The Control Cycle

The most important task of CNC systems is control of the moving axes of machine tools. The control cycle measures the position of the axis, receives the momentary values of the track calculated by the CNC central unit and through the drive controls the motors moving the axes. Figure 2 shows the elements of and a simplified model of the control cycle.

The UNIMERIC CNC solves the control task with software. Processing the measured data, computing the control algorithm and controlling the digital-analog converter are all tasks written in the program. Thus we have a possibility for correcting the measured data, developing the control algorithm and modifying the measurement and control resolution.

,pa

Figure 2. A Simplified Model of the Control Cycle



[Reading from top to bottom and left to right, the input in the NC box (broken line) is the Computed track element; on the right is the Drive; below are the Moving axis, the Tacho, the Motor and the Measuring element. The "Control cycle" diagrammed in the bottom half of the figure consists of: the Prescribed position, Position deviation, Prescribed speed, Actual speed and Actual position.]

A theoretical diagram of the control cycle is given in Figure 2. One can see that there are several closed chains in each cycle. The difficulty of realization derives from the fact that if we take the frequency transmission curve of the "drive-motor-axis" system then there are virtually no straight segments on it; we can measure an accumulation of difficult to construe resonances. (Just as an example to illustrate the difficulties, on one occasion we got resonances of several hundred Hz from a moving axle. Since the mass of the axle was several tons this appeared incredible. In the course of tests it turned out that the phenomenon was caused by the coupling parts used between the motor and the ball spindle turned by it.)

It is the task of the control cycle to handle several axes simultaneously. Movement on a turning axis takes place through, for example, a several hundredfold transmission. Moving "portal" type axes represents a special problem (see the right lower part of Figure 7) if the two sides of the portal are driven by independent motors. In such a case, when computing the intervention signal, one must consider not only the measured and computed position but also the tracking error of the "two" axes relative to one another.

The CNC is already used in the machine industry and is capable of receiving virtually every measurement transmitter (e.g. pulse transmitter, optical measurement scale, resolver, induction).

#### Measurement and Mechanical Precision

The machine industry is making ever greater precision demands of modern control systems. For this reason we realized services in the UNIMERIC CNC which make it possible to use the mechanical precision of the machine; that is, the machine-CNC system should be capable of manufacturing parts with at least the precision of or with more precision than the machine tool itself. The CNC does this by compensating for the systematic errors of the machine.

The machine manufacturers are doing much in the interest of solving the task in that they ever more frequently use direct measuring systems (that is, systems which measure not the revolutions of the motor but the actual movement), for example, an induction or optical measurement scale. The CNC makes possible use of measuring elements with a resolution of 0.5 microns, the programming unit is 1 micron and the precision of computations is 1 micron. We have begun development of a system in which the unit of programming and computation will be 0.01 micron.

To reduce the imprecisions of the machine tools we have introduced compensation for direction change errors; this modifies the dimension indicated by the measurement system by the average value per axis for every change of movement direction, including quarter cycle changes.

The UNIMERIC CNC is capable of compensating for measurement errors along the axes. If the repeating precision of the measuring elements is better than the measurement precision then we can calibrate the machine with a high precision measuring device--e.g., a laser--and we can store the necessary corrections in the CNC in a table with a maximum of 1,000 elements. The CNC approximates the error curve between two measurement points "along the straight line."

We also developed a method to correct the effect of the "carrying" axis on the "carried" axis. Introduction of this correction will take place this year. This will make it possible to reduce errors where, for example, the movement of the Z axis results in a movement in the Y direction because of an error in the perpendicularity of the Z axis which carries the Y axis.

#### The CNC and the Machine Tool Interface

Coupling the measurement systems and the drives is the task of the control cycle. Other functions are solved through the logical interface.

The UNIMERIC CNC is capable of solving this task at two different levels. In the simpler case we use a PLI (Programmable Logical Interface) unit which can receive 32 inputs and can control 56 outputs. The user can determine the control algorithm, and VILATI will build it into the internal programs of the CNC. If the number of outputs and inputs is substantially greater then we put into the CNC a PLI unit which can receive 256 inputs and control 256 outputs.

[Note: The "PLI" in the above sentence may be a typo for "PLC"--Programmable Logic Control.] The user can program the unit in a high level language with the aid of a special developmental system. Twenty K bytes of memory (RAM/EPROM) are available for the user program.

The PLC module is an independent subsystem within the CNC. It connects directly to the system bus and communicates with the central unit through a RAM buffer. In RAM the CNC gets a "theoretical" machine tool interface picture and here is where it issues the necessary commands.

An interpreter runs on the PLC processor; it controls the physical outputs, that is the various devices of the machine, according to a PLC program written by the manufacturer of the machine tool or written according to his needs.

The syntactical rules of the programming language derive from BASIC. The language handles bit and word variables. The bit variables are the inputs, outputs, internal variables, internal stores and timing (in progress/not in progress). Operations meeting the rules of Boolean algebra can be given among these. The word variables are registers, timing values and counters. With these we can do arithmetic operations and can use relations. Simple transfer operations are possible among the bit and word variables. The language includes conditional and unconditional jumps, subroutine handling, IF-THEN-ELSE and ON-SUB, ON-JMP instructions and BCD-BIN conversion, to and from.

#### Programming the CNC

The frameworks of this article permit a description of only a few basic principles.

Hungarian and international standards determine the foundations for programming; the UNIMERIC CNC perfectly satisfies these standards. In every case the units of programming are natural measurement units: geometric sizes in microns or millimeters; feeding speeds in millimeters per minute; and revolutions per minute, one per minute, etc.

The geometry of the part must be given in the programs; calculating the tool tracks necessary for processing is the task of the CNC. In the course of preparing the parts program the programmer does not have to know the dimensions of the tools; this is written into the CNC when the program runs. In the main planes the CNC is capable of computing the tracks (G41, G42) deriving from tool dimensions completely automatically; during three-dimensional movements operation is semi-automatic.

Preparation of programs is aided by a service of the CNC which permits the programmer to put the starting point of the coordinate system at any point on the piece; indeed, he can choose eight null points in one program, or shift the null point in any direction.

A separate program need not be written if one detail of a piece is the mirror image of another. In regard to any main axis (X, Y, Z) [as published] the CNC is capable of "mirroring" the program. Mirroring can be executed simultaneously for one, two or three axes.



## Computer Technology Services

In the first phase of CNC development it was not yet obvious what advantages would follow if the equipment operated under the supervision of a microprocessor central unit which could be freely programmed by us. The first CNC versions could do no more than the earlier NC equipment, where special purpose circuits realized every task.

Using methods already proven in computer technology brought a leap in NC technology development. Ever larger capacity memories appeared first. Today there is a 128 K byte RAM area in the UNIMERIC CNC to store parts programs (this would take about 400 meters of punch tape); we handle 100 tool length or radius corrections; 100 parameters can be stored for parameter programming; we can give eight independent null points with 6 coordinates each; we can describe the characteristics of the machine tool in 400 bytes; and we can correct mechanical errors on the basis of a 1,000 byte data table.

All of the 130 K bytes of data listed can be edited, can be entered manually, from punch tape or over a DNC channel and can be sent to screen, punch tape or the DNC computer.

Several services simplify preparation of programs:

- parametric programming,
- possibility for arithmetic operations among parameters,
- subroutine management (the CNC is capable of storing 64 subroutines simultaneously and a single call sentence can request an optional number of repetitions),
- parametric subroutine programming,
- conditional and unconditional jumps, and
- decimal point handling.

A screen which can be built into the CNC simplifies operation of the equipment and the "debugging" and running of the program; all essential data characterizing the program and status of the machine can be observed on the screen.

## Reliability, Test and Diagnostics

One of the most important parameters of automatic industrial systems is reliability. In the course of designing and developing the UNIMERIC CNC we tried to keep this in mind in all phases of the work.

A carefully selected parts assortment and a demanding manufacturing technology are indispensable conditions for reliability. It is also necessary to be able to recognize faults in the system in time to prevent catastrophic consequences.

## The Test System Serves This End

During system design we considered test and diagnostic conditions so that these would be served by every element of the system. When designing our programs we did not try to prepare independent tests--although, naturally, we use these too--but rather we strove to make checking an organic part of the functional procedures. Naturally we also provided the hardware tools necessary for this.

Here are a few examples of how we increased the reliability of the equipment:

- a test of all equipment runs after it is switched on and the CNC "does not start" if it notes an error during the test;
- every RAM area is parity bit protected and the CNC executes an "emergency shutdown" in the event of parity error;
- the functional modules watch "their own" devices; for example, is there power, is there no line break, did the central unit service them on time;
- the central unit tests the more important functions in background; for example the program store (EPROM) and data stores (RAM);
- the control cycles constantly monitor the position of the machine; if the machine is not in the computed position and the deviation exceeds the value permitted on the basis of the speed then movements are not allowed;
- during every data input the equipment checks the parity correctness of the data;
- sentences read in are checked syntactically and semantically.

We have listed only a few of our tests, but perhaps this is a good illustration of our concept. The function must carry its own check in itself. If the system discovers an error then it tries to discover the cause and the result of the test appears on the indicator.

## Processing Three-Dimensional Surfaces and Along Complex Lines

The development of design, designing methods and technology makes necessary the production of ever more complex parts. More and more moving axes are needed in the interest of solving the tasks on machine tools and the number of simultaneous movements is increasing. Rotating movements in addition to straight line movements have become necessary.

In Figure 3 one can see that the tool must move simultaneously along 3 axes in order to work along a line in the plane--e.g., the control track--and one of these is a rotating movement. In this case the task of the CNC is, for example, to control the "three-dimensional" movement formed by the X-Y-C axes.

The task becomes even more complicated in the case of a surface as shown in figures 4 and 5. The result of working with 3 axis movement (Figure 4) cannot be a continuous surface. With the method shown in Figure 5 this can be produced if the system formed by the machine and the CNC is capable of simultaneous 5-6 axis movement. Figure 6 shows the position of the tool at various points along the track.

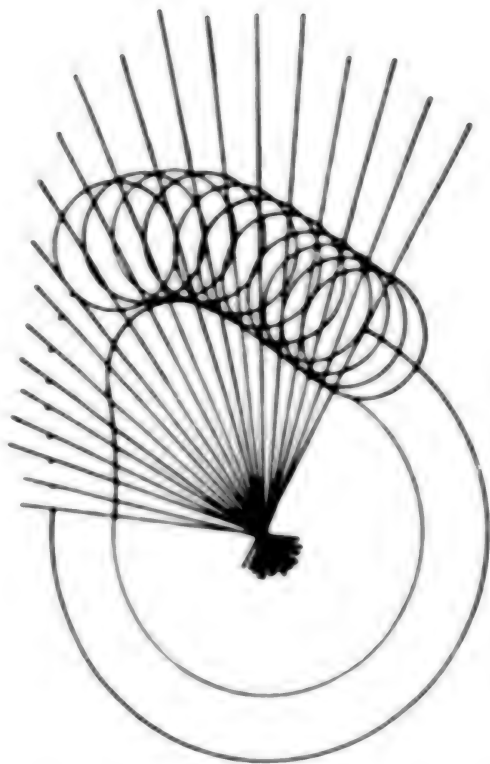


Figure 3. Working a control track along a 3 axis "three-dimensional" X-Y-C curve.



Figure 4. A continuous surface cannot be produced with 3 axis movement.

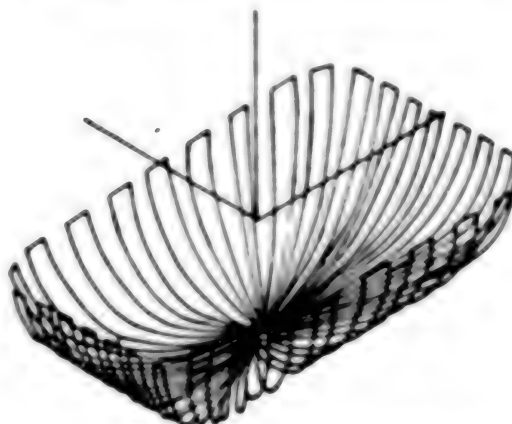


Figure 5. A continuous surface can be worked with 5-6 axis simultaneous movement.

The coordinated work of a number of developmental areas is needed to process three-dimensional surfaces and tracks. One task falls on the manufacturers of machine tools: In addition to the main axes the tool must be moved along a continuously turning axis. The other task is development of a CNC which is capable of controlling such movements along a programmed track.

At the 1985 Budapest International Fair the Esztergom Milling Machine Factory of the Machine Tool Industry Works (SZIMEM) and VILATI jointly displayed the results achieved thus far. In addition to the customary X-Y-Z axes the processing center exhibited was equipped with a tipping table and turnable axis main spindle. The UNIMERIC CNC is capable of controlling 6 axes simultaneously and it offers an input language which makes the working of three-dimensional surfaces programmable by the user. The geometric and technological description of three-dimensional surfaces is an extraordinarily complicated task which in the great majority of cases is possible only with computerized methods.

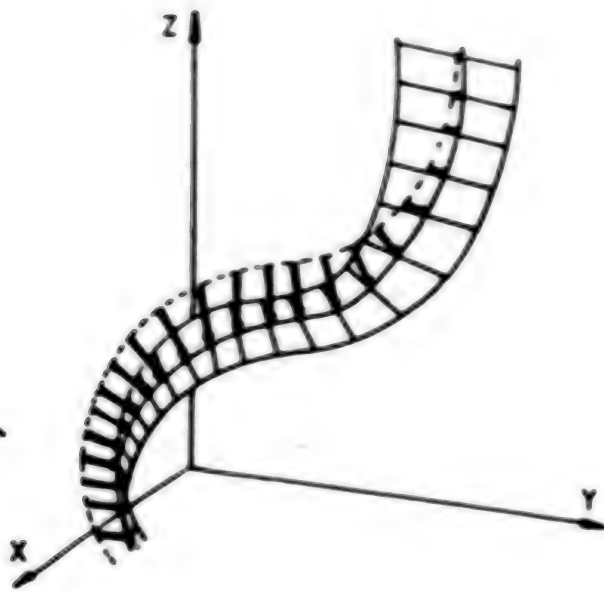


Figure 6. The position of the tool during the processing of a three-dimensional surface.

Development of these methods takes place in our country at three places--the Machine Manufacturing Technology Faculty of the Budapest Technical University, at the SZIMEM and at MTA SZTAKI [Computer Technology and Automation Research Institute of the Hungarian Academy of Sciences]. The programming of the surfaces is done by having the programmer break the track down into elementary sections--primarily straight lines. The "fineness" of the breakdown determines the precision of the desired surface. In essence the CNC executes a "six dimension straight line interpolation" between the beginning and end points.

In the course of the interpolation the CNC treats the tool as a three-dimensional vector as in Figure 6. Knowing the dimensions of the tool the CNC computes the components of the three-dimensional radial and length correction. It performs this calculation knowing the direction of the vector; the parts program must contain this; the physical tool is always in touch with different points along the track and this point is determined by the programmer by giving the direction of the vector.

In order to produce a surface of suitable quality the sizes of the elementary sections are sometimes very small; sometimes one must choose elements shorter than one millimeter. It follows from this that the CNC must process the program sentences extraordinarily quickly and the length of the parts program grows.

In the case of a complex workpiece one may need a program of several hundred K bytes. We do not plan to build stores of this size into the CNC since we believe that the DNC system should be used for manufacture of this type.

## DNC Systems

The online connection of CNC equipment with computers for various purposes is already natural. It is natural, but not unambiguously so for every user considers something else natural! In some of the applications they only want to do away with punch tape data carriers and peripherals; in the case of computerized production control they need information connected with manufacture; monitoring systems check the status of machine, auxiliary equipment and tools; and, finally, special demands arise within manufacturing cells.

At the price of continual development the UNIMERIC CNC is capable of satisfying more and more needs. In earlier versions we delivered a channel meeting RS 232 prescriptions over which only data transmission was possible. This service already made it possible to pass the parts program, data on null points, tool corrections and parameters from the CNC to the computer or from the computer to the CNC. Data transmission speed was 110-2400 baud.

In 1986 we prepared the DNC channel over which the above data transmission takes place within the framework of a protocol, data transmission takes place with error protection and every transmission is followed by receipting or transmission repetition. Now not only data travel over the line but also service messages, danger signals, etc. We developed the protocol according to the LSV 2 prescriptions of Siemens. Data transmission speed can be 1200-9600 baud.

In the course of spatial processing (5D or 6D), as we mentioned, a need arises to be able to execute a parts program of a size exceeding the internal memory of the CNC. A condition for this is to transmit the next program part during processing. The data needs of the CNC make a solution difficult; in critical phases this can exceed a value of 1 K byte per second and it is very difficult to transmit this on a serial line. According to our preliminary calculations the channel described in the paragraph above could solve this task with a buffer memory of well selected size, if the processing technology permits a few compromises. A study of this is under way.

A number of CNC or similar devices must be connected together in manufacturing cells. Within each cell there is need for closer cooperation than the DNC to ensure synchronized operation of the machines. We want to use a separate microcomputer for this task. It will constantly receive from all devices data pertaining to their status and will intervene in the operation of the system according to its own program.

In Figure 7 one can see a block diagram of our system. In it we have shown devices already manufactured and those under development. All our equipment is built on a uniform hardware base; the central unit, memories and peripheral coupling elements are made from the same modular system, thus simplifying the manufacture and servicing of the system.



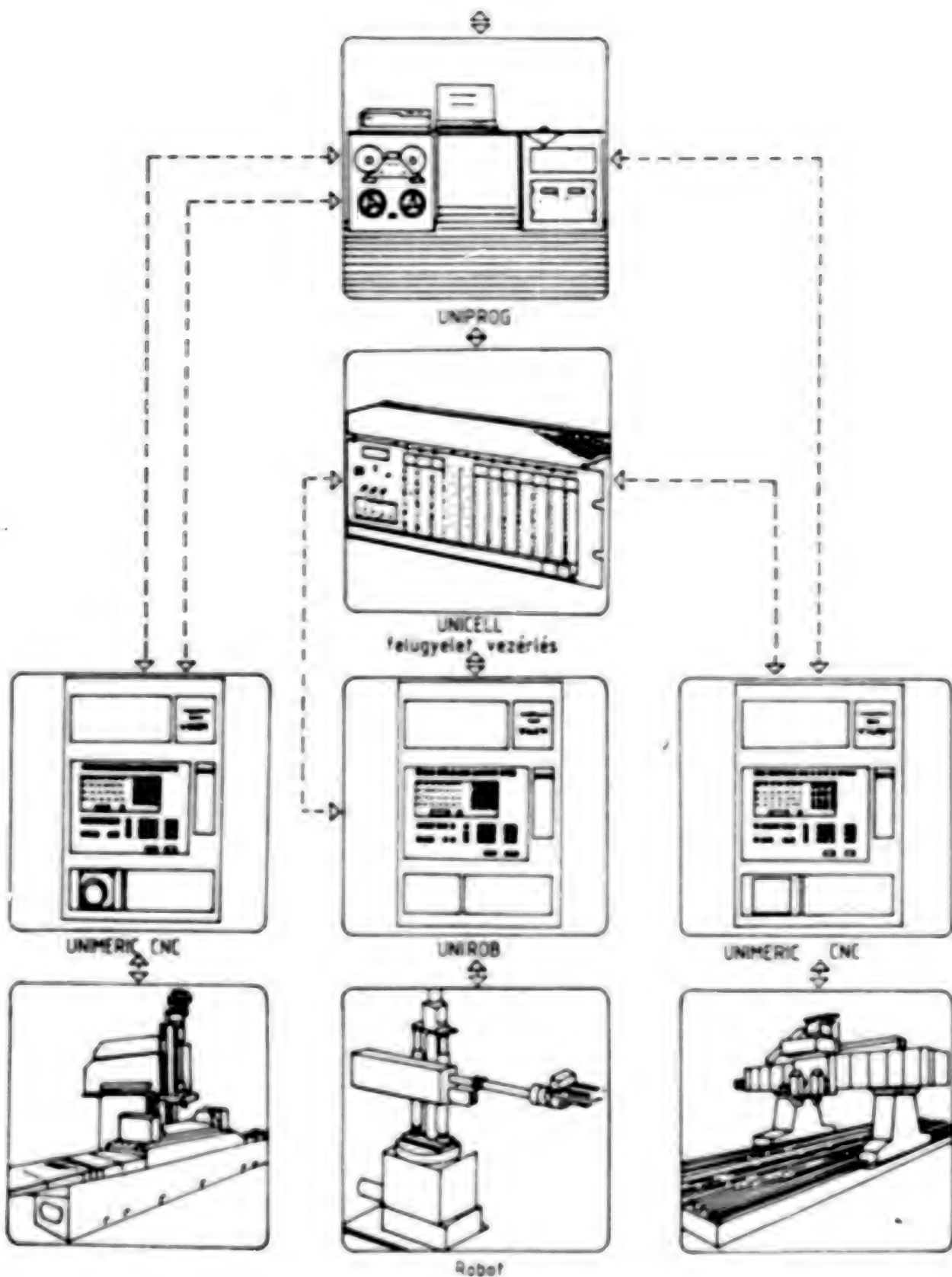


Figure 6. Our devices which can be used to build a manufacturing system.

## Monitoring Systems

Supervision is a basic requirement in manufacturing systems. This is comprehensive and means constant monitoring of the machine, workpiece, tools and auxiliary equipment and in event of trouble it results in automatic intervention or shutdown.

The complexity of the task requires that we work jointly with all institutions the experts of which have already gained experience in this area. The SZIM [Machine Tool Industry Works], the Machine Manufacturing Technology Faculty of the Budapest Technical University], the Machine Tools Faculty of the Heavy Industry Technical University in Miskolc and MTA SZTAKI are centers of this work. VILATI wants to contribute to a solution with ever newer services from the UNIMERIC CNC. In the interest of this we built a measurement possibility into the CNC. With the aid of a measurement tool one can monitor the status and base of the workpiece being processed and the dimensions at the end of processing. If suitable measuring tools are installed it will also be possible to check the tool.

Broad research is being done to make it possible to monitor the machine tool, working tool and workpiece during processing. Intercepting errors which arise will take place before they have caused a catastrophe. Measuring temperature, a study of vibrations and an analysis of the characteristics of electrical equipment could offer a basis for discovering irregularities in the process. This research is creating a possibility for manufacturing systems to function with less and less human intervention.

## High Level Programming Languages

Programming a CNC with manual methods is extraordinarily clumsy and is impossible in the case of complex workpieces and various three-dimensional surfaces. We want to aid the preparation of programs with the UNIPROG NC program development system. UNIPROG is a universal computer made of elements of our system; it is suitable for running, in addition to the traditional FORTRAN, BASIC, etc. languages, high level languages aiding primarily NC programming. The GTI [Machine Industry Technological Institute] and the SPE [Machine Tool Programming Association] have developed the GTIPROG and SPEAPT languages which facilitate a description of the geometry and contain the necessary postprocessors which produce the input data needed for the CNC.

Programming multi-axis processing is aided by a UNIFAX system developed jointly with the SZIMEM and a FAUN program system designed at the Machine Manufacturing Technology Faculty of the Budapest Technical University.

## Development of the Module System

Many hundreds of our devices made out of the module system have been sold and the favorable experience gained and the possibility of long-range continuous development have prompted us to continue our development in this direction.

The VLSI circuits which are becoming accessible on the world market offer new possibilities for a considerable expansion of the capacity of our units. In

this work we are counting seriously on the cooperation of a number of Hungarian enterprises (MTA SZTAKI, MMG AM [Mechanical Measuring Instruments Factory Automatic Works], MIKI [Instrument Industry Research Institute], etc.). With joint work we will be able to create an even more successful system.

#### Autobiographic Note, Gyorgy Barat

I am 45 years old, an electrical engineer. I began university at the Electrical School of the Budapest Technical University and finished with a red diploma in the Soviet Union.

I have worked at VILATI since 1966. In the first years I dealt with development of data preparation and data transmission systems. Since 1974 my task has been development of machine tool control equipment. My colleagues and I developed an SNC version of MACS-k NC equipment manufactured on the basis of a San Giorgio licence and then we joined in the development of the VILATI modular system. In 1979 I switched from hardware development to software development. Since then I have led the UNIMERIC CNC software development work.

I am married, my hobby is my profession, and my little girl is named Andrea.

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## HUNGARY: USE OF MICROCOMPUTERS IN POWER ELECTRONICS

Budapest MAGYAR ELEKTRONIKA in Hungarian No 3, 1987 pp 17-20

[Article by Sandor Honti: "Use of Microcomputers in Power Electronics"]

[Excerpts] Development of a microcomputerized direct current drive began with a license taken over from the Automation Faculty of the Budapest Technical University and the Heavy Current Automation and Equipment Institute of the Kalman Kando Electric Industry Technical College. Through this contract we got access to hardware (MHE=microcomputerized drive electronics) which can be used well in power electronics, primarily in the development of network commutation rectifiers, and to a program package realizing control circuits for direct current drives.

By using the microcomputerized drive electronics (MHE) one can satisfy user needs virtually without hardware changes.

## Description of the MHE Electronics Hardware

[See the figure on the next page.]

The cards indicated with a broken line are not included in the minimal system.

The cards are double EUROPA size and have two 64 pin indirect connections.

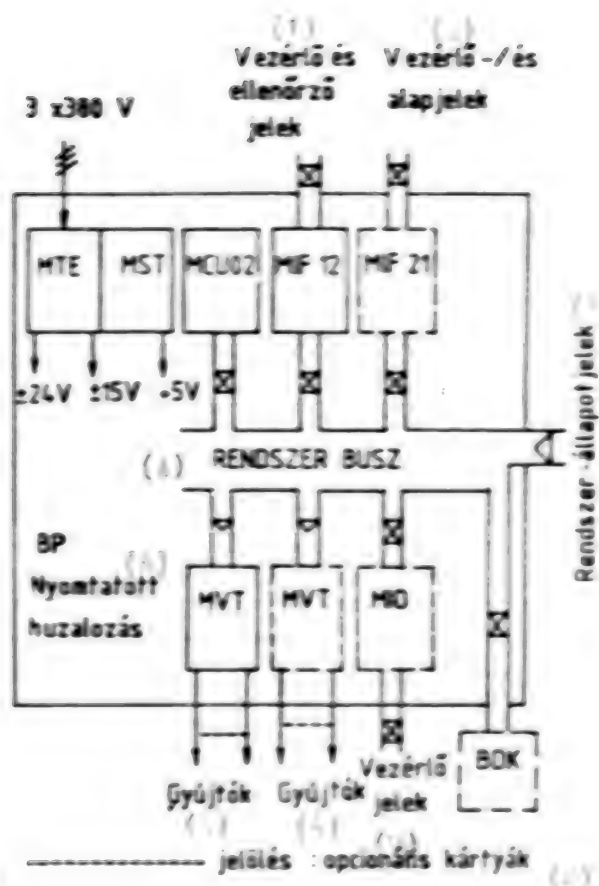
MTE, MST cards: produce from the 3 x 380 volts the power needed to operate the electronics and the ignition units.

MVT card: amplifies the ignition information to a power sufficient to ignite five parallel thyristors.

MIF 12 card: digitizes the control signals of the drive. It preprocesses information characterizing the state of the rectifier and the feed network.

MPU 02 card: has an 8085 microprocessor with 12 K bytes program memory and 2 K bytes data memory.

Figure 3.



Key:

- |                                   |                             |
|-----------------------------------|-----------------------------|
| 1. Control and monitoring signals | 5. BP printed wiring        |
| 2. Control and base signals       | 6. Igniters                 |
| 3. System status signals          | 7. Control signals          |
| 4. System bus                     | 8. Indicates optional cards |

The intelligent counters needed to measure the signals and the ignition port are partly on the card. The ignition port is one of the key parts of the hardware. In the state stabilized for control of the rectifiers the schedule number sets the time available to calculate a new ignition angle. In a six stroke connection this is 3.3 ms, and the real time for the rectifier is on the order of 10 microseconds. Thus ignition is solved by having the microcomputer, at start, fit the external network phase status to its own internal phase, then set the starting ignition angle and schedule number. After that it only handles changes. Because of changes in network frequency there is an ignition angle which charges in time for the constant current, so the program regularly synchronizes itself.

MIF 21 card: makes possible measurement of analog base signals.

MIO card: in the case of complex drives (e.g., rewinding) where the base signals can be produced only through computation it does the signal processing for the MPU.



It has its own 8085 processor, 8 K bytes of program memory and 4 K bytes of data memory. The RAM is accessed with the drive DMA.

#### Maintaining Contact With the Environment

Man-machine link: setting the parameters of the drive and measurement of them during operation can be done with the calibration and diagnostic device designated BDK. The available monitor program (which also runs on the MPU) makes it possible to start operation in the traditional way. When putting it into operation the transitional function is optimized by changing the parameters of the regulators. After disconnecting the drive program the list of parameters judged optimal must be burned in with the microcomputer.

Machine-technology link: we put in information about the network phase status and the conduction state of the thyristors through a voltage isolator outside the electronics. We isolate the other external signals on the interface cards.

Machine-machine link: a limited degree of cooperation of drives is possible without a separate monitoring unit. The link can be established through and/or parallel ports on the USART lines. It is also possible to communicate with a higher computer over these lines.

#### Description of Program

The program consists of two concurrent processes. The measurement and regulating program modules run under interrupt RST7.5. The schedule number of the rectifier determines the scheduling of the interrupt. We chose the run frequency of the several modules according to the time of the corresponding process. Figure 4 shows the scheduling.

Figure 4.

Periodic time for 50 Hz (6 x 3.3 ms)							
Program segment symbol	1	2	3	4	5	6	1
ASz	x	x	x	x	x	x	x
VSz	x			x			x
PSz			x			x	
GAK			x			x	
GSz				x			x
AG	x	x	x	x	x	x	x
MR	x	x	x	x	x	x	x

The interrupt routine does not take all the time available, 3.3 ms. We execute a background program in the remaining time. The background program consists of a synchronizing program and a monitor program.

With the exception of the current regulator the control cycles operate according to the principles described.

In the current regulator we return control to a relative ignition angle regulator on the basis of a numeric solution of the equation for an ohmic inductive loaded rectifier connected in series with the internal voltage. With this solution we can achieve good control properties in both conduction ranges although the design of the regulator is simple.

#### Advantages of Use

The swift development of information-electronics has so far left no mark in power electronics. The elements used have remained at the level of operation amplifier, comparator and analog multiplier. Only use of SSI, MSI circuits is characteristic in regard to digital circuits. The MHE system ends this technological gap, making possible the development of a homogeneous electronic technology. The advantages of use are the following:

- the assortment of parts used by manufacturers is narrowed;
- the number of elements decreases, so stockpiling is easier;
- simpler and cheaper systems can be manufactured;
- there is no need for forced D/A signal transformations;
- it is easier to develop large technological systems;
- the efficiency of designing can be increased with the aid of modern developmental tools;
- reliability and availability improve for the user;
- fast on-site repairs and testing during operation are possible;
- keeping reserves is simple;
- existing equipment can be changed flexibly to meet changing needs.

In addition to the advantages a significant need also appears--the need to provide further training for experts conversant with traditional electronics design and operation.

#### Autobiographic Note, Sandor Honti

I graduated from the heavy current section of the Electrical Engineering School of the Budapest Technical University in 1975. Following this I took a job in the metallurgical automation department of VILATI. I participated in reconstruction of the Cold Rolling Works of the Danube Iron Works, in developing astronomical equipment being made in cooperation with Carl Zeiss Jena and in designing auto industry test bench drives. I am a member of the MEE [Hungarian Electronics Association]. In 1979 I became a system design engineer. I am married and have two sons. My hobbies are skiing and mountain climbing.

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CSO: 2502/66

## HUNGARY: LASEROGRAPHIC FILM RECORDER

Budapest MAGYAR ELEKTRONIKA in Hungarian No 3. 1987 p 61

[Article by Laszlo Csipka: "Laser Film Recorder From ITEX." The first paragraph is an introduction by the MAGYAR ELEKTRONIKA editors.]

[Text] In our issue No 4, 1986, we published a description of a laser film recorder developed by the SZTAKI [Computer Technology and Automation Research Institute], which aroused the interest of a number of readers. There was an unfortunate error in the article, we failed to note that the IGV [Office Machine Industry and Precision Engineering Enterprise] had been liquidated 2 years earlier and that the ITEX Research-Development-Production Association had taken over the theme. The first laserograph was produced under ITEX development; it is presently suitable for preparation of printed circuit designs but software is being developed to make it suitable for printing industry photo-composition. At the same time they have developed, expressly for printing industry use, so-called roll-film projection equipment which can take the place of press composition equipment. We publish below--from the pen of deputy director Laszlo Csipka--a precise description of the laserograph.

The LEZERGRAPH LG-1 film recorder equipment developed by the MTA [Hungarian Academy of Sciences] Computer Technology and Automation Research Institute and manufactured by the ITEX Research-Development-Production Association records graphic and textual information produced by computer technology devices on light sensitive materials. It can be used advantageously to prepare large-size, faithful reproductions.

In the device eight modulated laser beams with a 25 micron raster distribution scan the surface of the light sensitive film or paper stretched on a turning drum. The light spots leave the light sensitive material illuminated or dark at the given raster points. Appropriately placed mechanical parts and synchronous signal transmitters ensure the high precision of the drawing.

The LEZERGRAPH can be an outstanding aid to the preparation of films of printed circuit and integrated circuit masks and to the preparation of mechanical and architectural drawings. The printing industry can use it for photo-composing, especially to project an entire newspaper page and to prepare masks for films and chromatic selection of line drawings. A laserographic film

recorder can also be used in processing medical pictures, aerial and space photographs and in artistic graphics.

Of the user program packages needed for actual use of the equipment the first to be prepared were programs suitable for preparation of printed circuit films.

The LG-1 and the printed circuit program package make it possible to produce very fine line films. The program package uses a description of the printed circuit written in the GTL language (which contains the coordinates for the beginning and end points of the lines, the line thicknesses, samples and other parameters) to produce in compact form the control data (the bit map) needed for direct control of the LEZERGRAPH LG-1.

We have also developed ways to connect the equipment to an IBM PC or compatible computers.

The chief technical parameters are:

--largest film size, 500 x 600 mm, drawing size, 480 x 540 mm;

--resolution, 25 micron fine raster;

--programmable raster size, whole number multiples of the 25 micron fine raster;

--precision, any illuminated point will fall within a circle 50 microns in diameter around the ideal point (the one programmed in);

--drawing time, 8 minutes for the largest film size;

--performance, taking into consideration the time needed to load and unload the film drum the exposure of one film takes about 10 minutes. Thus the output of the LG-1 is about 1.5 square meters of exposed film per hour.

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CSO: 2502/66

## HUNGARY: SDA SEISMIC DIGITAL DATA ACQUISITION

Budapest MAGYAR ELEKTRONIKA in Hungarian No 3, 1987 pp 21-25

[Article by Ferenc Szep: "SDA Seismic Digital Data Collector"]

[Excerpts] Structure and Operation of the SDA

The present representative of seismic data acquisition equipment is the SDA seismic digital data acquisition equipment developed by the Hungarian State Lorand Eotvos Geophysics Institute (ELGI). Its structure makes it suitable for broad use in various areas of seismic measurements. It can be connected (and has been connected) to small computers and computer centers and by connecting a digital tape recorder it can be used independently.

In what follows we describe the structure and operation of the SDA seismic digital data collector on the basis of the attached block diagram.

The signals of the sensors placed in the field reach the equipment through a cable. The electronic selection unit connects to its outputs the signal put in and the signal of the sensors as determined by the mode of operation. A maximum of 144 sensors can be connected to the input; the number of selected sensors can be 24, 48 or 96 in accordance with the number of channels connected.

The electronic selection unit is connected to an input switching unit which passes either the signals of the sensors or the signals of the test unit to its outputs. This unit is capable of connecting the designated wire pair of the cable, thus the desired sensor, to the spread monitoring unit for purposes of checking the cable and sensors (resistance measurement, insulation measurement).

The test unit built into the equipment can connect--for test purposes--to the inputs of the equipment analog signals embracing the entire frequency and dynamics range.

The input switching unit connects the signals of the sensors to the inputs of the pre-amplifier unit. This unit can be made in two versions, with or without a transformer. In equipment with a large number of channels (96 or more) one generally does not use a transformer input. The pre-amplifier unit of the SDA



is an amplifier without a transformer, with symmetrical input and asymmetrical output, the amplification of which can be set in four stages to values of 18, 24, 30 and 36 dB.

An important characteristic of the input stage is the common mode signal suppression, which can greatly reduce interference taken up by many kilometers of cable; this value is greater than 60 dB. Setting the amplification value can be controlled electronically.

The equipment is also made with different pre-amplifier series; use of a 12, 24, 36, 48 dB series is also common. We set pre-amplification at the maximum value amplifying the input signal without distortion. The reduced noise level for pre-amplifier input is 0.3 microvolts for 36 dB amplification and the maximum input signal is 1.2 volts for 12 dB amplification.

The frequency of useful signals is generally several times 10 Hz, there is often low frequency interference (e.g., the sound wave produced by the explosion), so the SDA contains low frequency filtering possibilities; this filter can be disconnected.

Its transconductance is 12, 18 or 24 dB per octave, as desired.

A number of series can be selected:

- in maritime applications, 5, 10 or 20 Hz,
- in continental applications, 12, 17 or 24 Hz or 12, 24 or 42 Hz.

A low-stop filter can be connected with an electronic control and one can similarly select the desired limit frequency from among the three possibilities.

Network interference is now an everyday concomitant of seismic measurements. Sometimes the 50 Hz interference is so strong as to suppress the useful signals. For this reason the SDA also contains a 50 Hz filter, which reduces interference with an attenuation of 40 dB in the 49.4-50.2 Hz frequency range. The 50 Hz filter can be switched on with an electronic control.

Since digitization is accompanied by sampling, interference above the useful frequency range can appear in the useful frequency range as noise reflected to the sampling frequency. To eliminate this effect the SDA contains high-stop filters the frequency of which is set automatically by the sampling time by electronic control.

These filters have a transconductance of 72 dB per octave and their limit frequencies are:

- 500 Hz with 0.5 ms sampling.
- 250 Hz with 1 ms sampling,
- 125 Hz with 2 ms sampling, and
- 62.5 Hz with 4 ms sampling.

The high-stop filters of the SDA equipment constitute a multichannel system. The outputs of the high-stop filters are connected to a low level analog multiplexer. The task of this unit is to connect the several channels to its

output in a time and sequence suiting the desired format. A few auxiliary analog channels, e.g. the signal of the oscillator, are connected here to the output at a time suiting the format. Control of the multiplexer is periodic, corresponding to the data part of the format.

After the low level multiplexer the signals go to the amplification control unit. This unit can produce 8 amplification values in steps of 12 dB from 0 to 84 dB. Every sample of every channel is sent to the analog-digital converter with the maximum possible amplification which does not cause over-control. The precision of the amplification steps is 1 percent.

In the case of a large number of channels a channel is connected to the digital amplifier for such a short time, with a small sampling time, that this time is not enough for amplification control. In such cases odd and even channels are connected to separate amplification control units (for example, in the case of 96 channels and a sampling time of 2 ms).

The digital amplification control unit passes the momentary amplifications in 3 bits at 12, 24 and 48 dB place values to the format unit.

The digital amplifier also has a so-called fixed operation mode. Then the amplification can be set with electronic control independent of the amplitude of the signal. This mode serves primarily testing purposes, but in the case of a few practical measurements also the equipment is used with disconnected amplification control.

The analog-digital converter transforms the signals amplified by the digital amplifier into digital signals. In the SDA this is a 14 bit unit working on the principle of successive approximation. The converter takes a sample of the signal and establishes a sign. It then compares the input signal to a reference. By changing the reference it goes from the larger bits to the smaller and changes the sample into a digital signal with at least the smallest bit precision of the converter but at most with a precision of 0.5 percent. In the case of using two digital amplifiers (e.g., 96 channels, 2 ms) one needs two analog-digital converters.

The 14 bits of the analog-digital converter and the 3 bits of the digital amplification control unit together give the momentary value. The format unit orders these; this unit folds together the values of the odd and even channels and puts in among the data the values of a time chain at the proper time and to the appropriate place value; these values are advanced by the sampling time. This chain of numbers is placed in the scheduling signal unit. The format unit also inserts a time signal which indicates the time the oscillation began.

The scheduling signal unit provides the signal series which operates the several units. The base frequency is produced with quartz precision. There are three base frequencies depending on the number of channels:

- 9.472 MHz in 24 channel operation,
- 8.576 MHz in 48 channel operation, and
- 8.192 MHz in 96 channel operation.

Selection of the appropriate frequency takes place automatically with electronic control. This unit also produces the auxiliary and scheduling signals needed to develop the format.

The record organizing unit provides the framework for the records. At the start signal arriving from outside the unit first counts the time necessary to write the heading (this is 200 ms), during which the central control unit--for example a small computer--writes the heading of the record to magnetic tape. The actual record starts after the 200 ms. The system then gives the explosion or excitation of oscillation command. In the SDA it is also possible to delay the writing of data. If the signal produced immediately after the excitation of oscillation is of no interest then the SDA can delay the writing of data for 0.2 to 100 seconds in steps of 0.2 seconds. This value can be set with electronic control. After the passing of the delay time the recording of data begins; the SDA then gives the digital data and the necessary scheduling signals to the data bus. The duration of a record can be 0.5 to 31.5 seconds; this time can also be set with electronic control.

#### The SDA as a Computer Peripheral

With the aid of a suitable coupling unit the SDA can be connected through the data bus to a tape recorder or to a computer for data recording or processing purposes. Control of the SDA and setting its parameters take place through the control bus. An 8 bit address determines which parameter of the SDA must be set and the parameter values are indicated by 8 bit data.

A write-in pulse and an operating mode signal (write-read) write the data into internal storage at a location determined by the address. This storage is a non-volatile memory unit; it retains the value of the parameters after being switched off. The parameters are checked in the read mode, then the content comes out, as 8 bits, from the memory designated by the address entered, and the SDA gives the write-in pulse as a result of the read signal.

The data bus and the control bus make the SDA suitable for use in the most varied systems. Connected to a computer it can be handled as a peripheral, naturally with the aid of a suitable coupling unit. In practice the SDA has been connected to a number of computers.

In the Volna maritime seismic data acquisition system, together with a suitable tape recorder and the MO51 small computer of the SZKI [Computer Technology Research Institute and Innovation Center], it is suitable for full value, autonomous data collection.

The SDA has also been connected to a processing center based on the R-10 and R-11 (Videoton computers). Not only can the records prepared by it be processed in the ship's computer center but through a coupling unit it is possible to have direct data traffic between the computer and the SDA. The SDA can be tested with the MO51 small computer and the R-11 computer and its operability and specifications can be checked automatically.

The SDA also works with a small computer in continental equipment; the SD-20 equipment is similar to the Volna equipment and is suitable for continental

measurements. In cooperation with VEB Geophysik in Leipzig the ELGI has developed, also for continental measurements, the SD-16 equipment, which uses a small computer of the Robotron firm based on the Z80 microprocessor.

#### Developmental Trends for Data Acquisition Equipment

With the use of computers all modern equipment is capable of automatic self-testing and self-monitoring. Exploiting the additional possibilities in computers and microprocessors can mean the development of equipment. Another possibility for progress lies in automatic calibration of equipment, in error analysis and in automatic error correction to a certain depth. With the aid of a computer measurement can be made technically automatic. Analyses which can be done on a computer can offer aid in organizing the measurement; the burden on large computer centers can be eased with immediate classification of data, preprocessing and scrapping of records.

In recent years the seismic cable has become the chief obstacle to increasing the number of channels and the resolution of continental seismic measurements. Development has been in the direction of so-called telemetric systems instead of producing, and especially using in practice, cable with a larger number of wires than the presently used cables, containing 140-150 wire pairs. These systems do not send the analog signals of the sensors to the data acquisition equipment but rather immediately digitize these signals, passing them along the cable to the central unit in the form of a multiplex signal.

Thus in a telemetric system the traditional seismic data acquisition equipment is divided into two parts--the so-called field box, which digitizes the signals of 1, 2 or at most 12 sensors, and the central unit which controls the operation of the boxes and collects and records their data. A simple cable connects the boxes with one another and with the central unit; most often it is a special coaxial cable, with one or two wire pairs. In recent years telemetric systems have appeared in practice but so far they have not spread generally. Their possibilities, however, in data collection and automation are greater than those of traditional equipment so their gradual spread can be expected.

#### Autobiographic Note, Ferenc Szep

I obtained a diploma in communications engineering at the Electrical Engineering School of the Budapest Technical University in 1968. Since then I have worked in the seismic instruments department of the Hungarian State Lorand Eotvos Geophysics Institute. At present I am a chief scientific colleague in a laboratory leadership position. I participate as theme leader in the development of large seismic equipment. Service patents have developed from three of my invention proposals; these are solutions now used in instrument designs. In 1982 I took the test in patent law. In 1983 I was awarded the decoration For Outstanding Work. At present I am working as theme group chief on development of a so-called telemetric data acquisition system. I am married and have two daughters.

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CSO: 2502/66

## R &amp; D SITES SUFFER SHORTAGE OF FUNDS IN HUNGARY

Budapest HETI VILAGGAZDASAG in Hungarian No 20, 16 May 87 p 51

[Unsigned article: "R & D Funds"]

[Text] The demands being made of scientific research sites have increased but the conditions for research have deteriorated in Hungary in recent years. Between 1981 and 1985 the real value of the sum going to research and development here decreased by one percent every year--according to a just published Academy report which reviews the research experiences of the Sixth 5-Year Plan. For example, because of various measures the research institutes were forced to give up subscribing to journals and buying primary materials and parts. At the same time the personnel limits, which lasted for several years, caused sometimes serious replacement problems in new scientific areas.

The 12 percent of domestic scientific researchers (3,000 people) in the institutes of the Hungarian Academy of Sciences (MTA) used 14 percent of the research funds, a total of about 15 billion forints, in the first half of the 1980's. Of this 41 percent went to basic research, 40 percent to applied research and 19 percent to experimental developments. The state support making up the smaller part (40 percent) of the receipts of the institutes is more and more sufficient only to cover maintenance costs; to a very large degree the institutes finance research itself out of the receipts for special work. Thus the scientific achievements came closer to practical application but at the same time--as the Academy report notes--the demand for more comprehensive theoretical creation has been forced into the background in the past one or two decades.

Between 1981 and 1985 the institutes of the MTA participated in a total of 32 significant research programs. Seven of these studies were connected to the National Long-Range Scientific Research Plan. For example, the theme dealing with a comprehensive scientific study of the natural resources of the country had a budget of 365 million and research studying development of public administration and of economic policy managed with 35 million and 46 million respectively.

Another part of Academy research, for example, was directed, as part of the National Medium-Range Research and Development Plan, at microelectronic



developments (this cost 2.1 billion dollars), while 391 million forints was turned to research serving safe operation of nuclear power plants.

In addition the Academy did research on the basis of theme offers from the Agitation and Propaganda Committee of the MSZMP Central Committee. The three studies here examined the accomodation and innovation potential of Hungarian society, the development of national awareness and the public life activity of the churches, with budgets between 5 and 8 million forints.

The institutions did research on another 11 themes on their own initiative, among other things on prospecting for energy sources and laying scientific foundations for youth policy.

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CSO: 2502/68

## MINISTERIAL PAY EQUIVALENT APPROVED FOR HUNGARIAN ACADEMICIANS

Budapest HETI VILAGGAZDASAG in Hungarian No 20, 16 May 87 pp 50-52

[Interview with T. Ivan Berend, president of the Hungarian Academy of Sciences, by Endre Babus: "Scientists and Incomes; An Academic Question"]

[Text] Last week the Hungarian Academy of Sciences held a general meeting to elect members. The body--as was shown by this meeting too--has received a significant role recently in preparing government and other political decisions. In the following interview we asked T. Ivan Berend, economic historian and president of the Hungarian Academy of Sciences, about the role played by the Academy in society and about the new pay system for Academicians, among other things.

[Question] A few days before the beginning of last week's general meeting a government decree raised the honoraria for members of the Hungarian Academy of Sciences. What were the antecedents of this decision?

[Answer] The change had become increasingly urgent for two reasons. One was that the monetary awards connected with scientific degrees had not been raised in Hungary since 1950. In the beginning the 2,600 and 2,000 forint honoraria established 37 years ago for regular and corresponding members of the Academy respectively were by and large equal to the pay of university professors, but today they have shrunk to a ridiculously low sum. The 1,200 forint monthly supplement for a grand doctor's title and the 472 forint monthly supplement for a candidate's title have been similarly devalued. For many years this has been a serious grievance of Hungarian scientific society, which has been brought up repeatedly at general meetings of the Academy. Scientists of such rank and capacity can usually get additional income with various jobs, but this often led to a scattering of research energies. The increase in Academy honoraria as of 1 May finally creates more favorable conditions for research and a concentration of intellectual forces in the case of the most highly qualified research and university people. There is no doubt that this government step must be greeted as the sign of a turning point in respect for intellectual work.

On the other hand an increase in the honoraria was expedited by the fact that in the past 7-8 years the Hungarian Academy of Sciences has taken care of significant public life tasks. Our bodies took part and are taking part in the

preparation of government decisions and in providing expert opinion. The new distribution system for research money based on broad jury judgments puts an additional significant task on the Academy, which the membership takes care of without separate honoraria.

[Question] The new financing system now introduced--if I interpret the changes properly--provides academicians with income essentially corresponding, at any given time, to the pay of a minister in the case of regular members and to the pay of a deputy minister in the case of corresponding members.

[Answer] In the case of both classes the permanent income of members of the Academy will hereafter move between the value limits for the ministerial wage category. In essence what this means is that the monthly pay or pension of academicians will be supplemented by the Academy each month to a sum corresponding to the wage category mentioned; in the case of corresponding members, at this time, the supplementation will be to a sum between 24,000 and 28,000 forints and in the case of regular members to a sum between 28,000 and 30,000 forints.

[Question] This measure more or less seems to solve the problem of material recognition for the two hundred some odd domestic academicians. But the great majority of scientific researchers are badly paid--as you also mentioned. In a number of cases the Academy itself has called attention to the fact that alarming contraselective tendencies are effective in places in domestic scientific public life; in plain language, outstanding brains in more than one case turn their backs on a scientific career, because of the low pay.

[Answer] By raising honoraria for academicians we have only taken the first step in restoring a realistic evaluation of scientific work. Obviously additional changes are needed, and within a foreseeable time. It appears that there will be a partial possibility for this in the years ahead--in several steps. It is an already decided fact that as of 1 January 1988 the supplement going with the grand doctor's title will increase from the present 1,200 forints a month to 4,000 forints, built into the pay. In addition the Academy has made a proposal to change the financing system connected to the candidate's title. Our proposal was that hereafter, instead of the life annuity supplement, candidates be awarded a rather significant one-time sum depending on the quality of the dissertation. But in the course of the debates connected with this serious critical observations were voiced regarding our system of scientific qualification as a whole. The present five degree scientific system shows a practically feudal hierarchy unique even internationally. The scientific degrees built one on another--university doctor, candidate, grand doctor and finally two academic titles--forces researchers to prepare three large dissertations, while in many areas there is really no need for such thick monographic studies. Finally, in the wake of these criticisms, there was a decision for the Scientific Qualification Committee and the Academy to jointly review the present qualification system and on this basis the government will decide--probably at the end of 1987--on a possible modification of scientific degrees and the awards going with them.

[Question] Before the general meeting you released to the press a report from which it appears that in the past year the bodies of the Academy offered

opinions or did their own studies in a number of questions of general interest. For example, the presidium delegated a committee to study the preparation called Celladam and debated an Academy study analyzing the causes and effects of the acidification of the environment. In addition, in 1986, opinions were given on more than 150 state measures and draft regulations. But why is it that for the most part the Academy performs its experts activity behind the government scenes? Are you hesitant to submit to public opinion the sovereign position of science--if it sometimes differs from the opinion of certain state administrative organs?

[Answer] This question is closely related to the problematics of the functioning of the domestic political mechanism. The solution does not depend on the Academy alone. There might be a need for special openness a good bit broader than at present in Hungarian public life as a whole in the interest of laying the foundations for and social control of decisions. And I would not consider it sacrilege to place the Academy's position before the public even in cases where we agree only in part or not at all with the government ideas. (It must be considered natural that sometimes politics also reckons with political factors, such as the international interdependencies of some step, which are not necessarily considered by a scientific approach.)

I also consider it necessary to note that there is also a sphere of our experts activity which is linked to the internal phases of governmental or political work, namely when we give our opinion at the request of the prime minister or secretary of the Central Committee and, naturally, communicate with the requester. In such cases I myself would not consider it necessarily justified to go before the public with our opinion. But we could list in this latter group only 20-30 percent of the positions we take; in the other cases there would be no obstacle in principle for the position of the Academy to be expressed before public opinion more frequently than at present.

[Question] The Academy probably regards preparation of the new, modern encyclopedia as one of its greatest undertakings. Since the domestic public was subjected to serious disappointments in encyclopedia matters in past years it would be interesting to know how the work stands at present. When can one expect publication of the series, and with what schedule?

[Answer] At the beginning of this year a small editorial committee, nine members, was formed which intends to use a computer background to put under one roof, in 1987, the key-word system of the encyclopedia, which consists of 160,000 entries. This key-word catalog will essentially determine the internal ratios of the series. According to our plans the first two volumes will appear in 1990 or 1991 and we will finish the 16 volume work by 1998--counting on publishing two volumes per year. In the course of editing we would like to use, also as a revitalization of tradition, the key-word studies of the best Hungarian encyclopedia thus far, the Pallas classic, written by Krtvos, Koranyi, Hutyna and other greats. We would also like it if the best experts participated in writing the encyclopedia. So at last week's general meeting of the Academy I turned to the academicians and doctors of the sciences, a total of about 1,500 scientists, with an appeal for everyone to regard at least the preparation of a key-word study as a moral obligation.

[Question] On the basis of the list of new Academy members elected last week it appears that outstanding scientific performance has again been recognised here with the highest scientific degree with a significant delay. The average age of the newly elected regular members is a good bit over 60 years, although that of the corresponding members is this side of retirement age. Why is it, for example, that it is virtually impossible for a social scientist to be admitted among the members of the Academy here before the age of 50 years?

[Answer] Let me emphasize that of the 27 new--corresponding--members of the Academy just elected nine are only in their forties, and this is substantial progress. The average age of the new corresponding members is roughly 53 years. We could hardly achieve more in the present scientific qualification system. Researchers in Hungary--as I said--must travel a most long and many-stepped path to reach Academy membership. In the great majority of cases this is impossible under the age of 40-50 years. Of course there are exceptions, primarily among mathematicians who traditionally are the youngest academicians, they sometimes reach this stage in their thirties. A substantial change in this area can be achieved only after a reformation of the scientific qualification system. But we must still do much within our bodies so that people will not say in the case of younger researchers who are suitable on the basis of their scientific accomplishments--and today this certainly happens--that "they still have time." We need a broader inclusion of young talent.

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CSO: 2502/68



## HUNGARIAN ACADEMY INSTITUTES, PAKS NUCLEAR POWER PLANT

Budapest MAGYAR TUDOMANY in Hungarian No 4, Apr 87 pp 283-291

[Article by Zoltan Szatmary, doctor of physical sciences, deputy director of the Central Physics Research Institute of the MTA (Hungarian Academy of Sciences): "The Institutes of the MTA and Paks"]

[Text] The existence of and further construction at the Paks Nuclear Power Plant defined the direction, frameworks and content of nuclear energy research taking place in the institutes of the MTA between 1981 and 1985. Nuclear energetics is typically a peak technology; its introduction and continual use are extraordinarily research intensive. The author lists convincing arguments and achievements in this respect.

In the following we summarize how the research and development work done in the institutions of the MTA (the KFKI [Central Physics Research Institute], the ATOMKI [Nuclear Research Institute] and the Isotope Institute) aided the Paks Nuclear Power Plant investment, putting it into operation and increasing its safety. Our review, however, cannot be complete because of space limitations. We will talk primarily only of those achievements which were realized prior to 1985, so we will speak, for example, only in passing of the domestically developed control system placed into operation in 1986 for the third block of the Paks Nuclear Power Plant.

It is perhaps natural for many but we note in order to avoid misunderstanding that many enterprises and planning and research institutes took part in solving the tasks connected with the nuclear power plant and did successful work. Of these we pick out here only the results achieved by the research institutes of the MTA, which represents no small difficulty because there is hardly a task which a single institution could have solved by itself. We hope that it is acceptable that--in the interest of easier readability--we have not stuffed the text with frequent references to the partner institutions.

We will try to show that the Academy institutes were present and achieved results everywhere where problems of a nuclear type arose, beginning with the active zone and extending outward to the environment of the power plant and in a number of places at the power plant. The domestic nuclear energetics industry constantly requested the contribution of science, formulated tasks itself and always strove to use the scientific results. The cooperation of

industry and research in this area can be called exemplary. One institute of the MTA coordinated the A/11 program of the OKKFT [National Medium-Range Research and Development Plan], which in itself gave a worthy contribution to solving the tasks at Paks.

#### The Active Zone

A dual goal hangs before the operators of a nuclear power plant--on the one hand they must ensure that the reactor operates safely at every moment, that the consequences can be kept under control even in the event of an unexpected failure; on the other hand they want to get as much energy as possible from the fuel load, or they want to operate the load as long as possible and with the greatest output possible. Of these two goals the first obviously sets limits for the second, the power which can be obtained is limited for safety reasons.

In practice what has been said is realized first of all through computations. Before each reloading of the reactor they try to determine the composition of the new load so that--in a manner satisfying the safety restrictions--it will be possible to keep the reactor in operation at nominal output while using as little uranium as possible for a given time (about one year). Operations are based on signals from measuring equipment located in the reactor. If the course of operations deviates significantly from what was planned then new decisions are needed, decisions based on new calculations regarding the further course. These decisions cause a problem especially when they simultaneously affect economicalness and nuclear safety. The precision of the computer programs used here, the detail of the computations performed, the quality of the operational measurements and to no small extent the way in which they are displayed significantly influence not only the safety of energy production but also the strictness of the operational limitations mentioned. In other words, the quality of the things mentioned has an effect on both safety and economicalness and is even interdependent with guarantee questions.

In the initial phase of the operation of the blocks the shipper maintains the right to check the optimization computations serving as a basis for fuel orders. It follows from this that the programs and computation methods used can only be internationally accepted procedures which have been tested thoroughly. Naturally the same applies to the programs used in safety analyses.

In the case of the Paks nuclear power plant such tools had to be created for two reactor types--VVER-440 and VVER-1000. (In the case of the Paks nuclear power plant the first four reactor blocks belong to the former type, additional blocks will belong to the latter type.) Traditionally the description of the active zone is broken down into two parts only loosely related to one another--a description of the release of energy through the fission chain reaction (reactor physics) and a description of the cooling of the reactor and of its behavior under breakdown or accident conditions (thermohydraulics). In the case of the VVER-440 this separation has not yet led to excessively large computational errors. In general we use the Soviet developed BIPR program for reactor physics operational computational purposes. We took this program over, but in cooperation with the authors we developed it

further in the direction of taking thermohydraulic feedback into consideration. In the interest of an experimental check of the BIPR program we collected in a special databank created for this purpose the operational data for a few VVER-440 power plant reactors operating in CEMA countries. Naturally the Paks nuclear power plant joined in this work.

As for reactor physics so in the area of thermohydraulics also a computerized procedure has been developed which is capable of analyzing the thermohydraulic safety of the active zone when the primary cycle of the nuclear power plant is intact and in the event of breakdowns. Experiments performed on equipment created for this purpose (the High Pressure Water Cooling Loop [Nagynyomasu Vizhuteses Hurok]=NVH) made possible an experimental verification of this analysis. The leading Soviet scientific institutes for the VVER type made the program into a designing aid for this type and thus officially declared the usability of the program for analysis of processes taking place in the reactor. The information obtained was used directly as well.

An analysis of breakdowns showed that an accumulated conservatism characterizes the present safety analysis (in other words, the operational restrictions are too strict) and uncovered reserves deriving from this. In the interest of this we reconstructed the procedures and data used by the Soviet designers. We established that disregarding pipe breaks one of the most unfavorable events from the safety viewpoint was a sudden jamming of a main circulating pump. With an analysis of this event we created the thermohydraulic background necessary for increasing output. All this contributed to increasing the output of the first two blocks, already done, and thus resulted in significant economic profit.

For the VVER-1000 computations one needs a computational apparatus substantially more complex and developed than the BIPR; we began to create this more than 10 years ago. As we mentioned above it is necessary here to link the reactor physics and thermohydraulic approach. A number of elements of the program system representing a solution have been created already but we slowed the work directed at this because of the tasks connected with the VVER-440 blocks being put into operation and we are only now speeding it up again with the decision to go on with the Paks VVER-1000 blocks. There continued to be, however, those measurements the results of which serve as an experimental check on these programs.

We did a physical study of the fuel element lattice making up the active zone in the ZR-6 critical system. The experimental part of this lattice study, more than a decade old and involving ten countries, is essentially completed. In the course of it we measured the most important physical characteristics of the lattice in a broad range of the most important parameters of the fuel element lattice (lattice spacing, enrichment, boric acid concentration, temperature). This created the basic physical data which make possible an experimental check of the computer programs serving nuclear power plant computations. There has been a critical evaluation of the first part of the experimental results obtained and the first volume of a series containing and discussing these has appeared in Russian and English. In addition to creating data serving to check computer codes we also made a series of physics discoveries, primarily in the area of the physics of power plant (so-called

disturbed) fuel element lattices. A similar series of experiments has been done in the area of thermohydraulics also, with special regard to the so-called critical heat flux, which is one of the key starting data for choosing nominal output.

### Putting It Into Operation

Putting it into operation is an important phase in the operation of a reactor. A significant interest attaches to performing this series of operations in the shortest possible time and providing measurement data of the best possible quality. We further developed for measurements to be done in power plant reactors the equipment developed earlier for laboratory measurement purposes, primarily fast and precise reactivity measurement. We proved its usefulness on nuclear power plant blocks operating in Czechoslovakia and Bulgaria and then we used it for the Paks power plant blocks. Thus it was possible to do the measurements when they were being put into operation more quickly and more precisely. On the one hand use of the equipment accelerated putting the reactor into operation and on the other hand it practically immediately provided evaluated and useable results (in contrast to other places where the evaluation used to take several months).

In the course of putting the first block into operation we also participated in primary cycle thermohydraulic measurements. Within the framework of this we determined the quantities and defined the characteristic curves of the main equipment, data needed for operation but which cannot be determined after the equipment is put into operation. The practical utility of the work is obvious but at the same time it gave the researchers participating in it experience which nothing could replace.

### Diagnostics

It greatly increases the operational safety of a nuclear power plant if it is possible to recognize trouble at an early stage. If we compare the two VVER reactors from this viewpoint then we see that the VVER-1000 is substantially more stepped-up and complicated than the VVER-440, which is shown best by a comparison of the specific volume energy production of the two types--110 and 80 kW per liter respectively. So in the case of the latter type diagnostics are a very useful tool for increasing safety but in the case of the former the use of a properly developed diagnostic system is indispensable from the viewpoint of safety. A significant part of the research results obtained in this area in regard to the VVER-440 will serve as a foundation for VVER-1000 diagnostics as well.

We installed a diagnostic system for every Paks block put into operation thus far. (Footnote: Despite the agreement made in regard to the present series of articles we should note that the diagnostic system was created in cooperation with the VEIKI [Electric Power Industry Research Institute] because it is the position of the latter that "here the MTA institute created a substantially smaller part of the system installed than did the cooperating partner." The statement quoted is true in regard to contractual volume.) These are based primarily on an analysis of fluctuating processes (noise). We have done internationally recognized theoretical and experimental research in the area



of noise analysis for a long time. On the basis of this we hoped that we could create a diagnostic system which would be operational even under plant conditions. The key question for diagnostics is the extent to which we are capable of interpreting theoretically the experimental information provided by the system. Here the old saying according to which "there is nothing more practical than a good theory" is literally true. So we regarded the first years primarily as a time to acquire experience and only later did we expect that we would be really capable of recognizing trouble as it developed. In any case the first practical result has been achieved--we succeeded in revealing and localizing an anomaly which took place as the vibration of a control rod. This is reassuring in regard to the future.

There were two main experimental bases for the research aiding interpretation:

--On the one hand research took place at the Rheinsberg nuclear power plant (GDR) within the framework of a quadrilateral (Czechoslovak-Hungarian-GDR-Soviet) diagnostics agreement. The goal was laying the foundations for creation of a diagnostic system to be installed for the VVER-1000 reactor type and use of it for the Paks blocks. The experimental material made possible interpretation of a significant proportion of the measurement information and indicated those areas where further research was needed. Here we obtained immediate nuclear power plant experience which we used in creating the diagnostic system installed at Paks.

--Methodical studies were done on the ZR-6 critical system, the goal of which was to separate from one another and study under pure conditions phenomena which appeared together in a nuclear power plant and which could be used for diagnostic purposes. The methodological results thus obtained paid off directly at the Paks Nuclear Power Plant when we succeeded in localizing in the way already mentioned a vibrating control rod.

#### Control Technology

As we already mentioned operation of the reactor is based on data received from measuring systems located inside the reactor. Since this is a complex system the mass of information available could not be used without proper processing, reduction and display; indeed, it could even be confusing for the operator and according to experience this is a source of danger. For this reason we developed in the first two Paks blocks the VERONA system which displays for the operator on color screens in the block control room the spatial distribution of the output of the reactor. With its aid the operator can monitor the data for the most heavily burdened fuel cassettes and their safety reserves. In addition to increasing safety the system also has economic significance since its use makes possible a more even distribution of zone output and thus better utilization of the nuclear fuel. The VERONA systems of the first two Paks blocks have been operating as plant systems since the beginning of 1985.

Control systems for blocks 3 and 4 based on TPA-11440 computers are being built with the cooperation of a number of enterprises and research institutes. The so-called upper level of these systems contains monitoring of the active zone, which extends to all the services of the VERONA systems of blocks 1 and



2 but also offers additional services compared to these. For example, with its aid the operator will be able to plan the optimal course of an output modification. This work was completed on block 3 only after 1985. Another large undertaking going beyond 1985 is creation of a full scale training simulator in a Finnish-Hungarian cooperation project. So we will not go into the details of these here.

#### Reactor Vessel

From the safety viewpoint the most important component of a nuclear power plant is the reactor vessel. For this reason the condition of the vessel must be checked continuously. Test samples of its own material are placed inside the vessel. These are subjected to the same neutron radiation--coming from the active zone--as the vessel itself (disregarding a recalculation factor). The time that the reactor vessel can be used safely (thus the life expectancy of the vessel) can be determined on the basis of a fracture mechanics study of test samples periodically removed. We designed and built for this purpose a radioactive materials study laboratory and manipulation box system. This aided the work of a laboratory with a similar mission established at Paks.

Using radiation done in a research reactor we studied the sensitivity to neutron radiation of the steel used for the vessel. Using this study routine and the results obtained we developed a methodological guide according to which the test samples taken from the reactor vessel are tested. All this contributed greatly to the error free study of the test samples located in the two already operating reactors and to an evaluation of the results, on the basis of which it could be reported that the life expectancy of the Paks vessels corresponds to the design prescriptions.

#### Corrosion

Corrosion layers form on the surface of stainless steel and particles produced by corrosion appear in the heat carrier. We worked out procedures to produce simulated surface layers and to characterize the surface layers. Using a number of test methods we determined the atomic composition, thickness, crystal structure, valence, electrical properties, and growth kinetics of the oxide layer being produced and the proneness of structural steel for local corrosion. We also studied samples from the primary cycle of the Paks nuclear power plant.

We developed an elutriation procedure using radioactive indications combined with gamma spectroscopy to determine the size distribution and identify the radioactive components of the radioactive corrosion particles floating in the heat carrier. We created a laboratory loop operating at a pressure and temperature corresponding to operational conditions at Paks to simulate the settling out and redissolving of floating corrosion particles.

With the aid of the devices created and the methods used we checked the circulation washing and hot route of the first two blocks of the Paks Nuclear Power Plant. The metal and fluid samples from the operating reactor showed very little general corrosion and the production of little radioactive material.

Regular visual checks of the surface condition of the vessel, the structural elements and the fuel cladding are an important part of safety surface monitoring at a nuclear power plant. We developed an optical monitoring system to identify spent fuel elements (for safeguard purposes); this system is suitable for very high resolution visual checks of radioactive structures even under a thick protective water cover. The equipment created--which has technical parameters unique in the world--is used regularly at the Paks nuclear power plant (and in a number of foreign power plants). In this way one can find beginning corrosion, cracks and other defects in time.

#### Spent Fuel Elements

The spent (used up) fuel element bundles unloaded from the reactor are placed in a resting basin beside the reactor where they must spend 3 years--according to the original thinking--before shipment to their final storage place. According to present international agreements the Soviet Union will take back spent fuel elements after a 5 year rest, so it was necessary to see to correspondingly prolonged storage in the area of the power plant. Plans for a separate storage site to be built for this purpose are available, according to which construction of the site would cost on the order of a billion forints. In the interest of sparing this expense a program was started in which our task was to prove with detailed reactor physics computations that the storage capacity of the resting basin could be substantially increased if the fuel element bundles in it were placed more densely but separated from one another by boron steel structures. Dense storage was realized and resulted in very significant savings.

On the basis of a study of the stored fuel element bundles one can determine how much energy individual bundles produced during their time in the reactor. This information is valuable in part from the viewpoint of checking the reactor calculation programs but also on the basis of it one can check adherence to the nuclear barrier agreement. We developed nuclear physics, neutron activation and gamma spectrometry methods for these measurements.

#### Personal Dosimetry

A personal dosimetric service operated in a number of other areas prior to construction of the nuclear power plant so the measurement technique questions were already clarified to a large extent. At the nuclear power plant the gamma and beta radiation dosimetry for operating personnel is based primarily on the thermoluminescent technique. The interference effects of neutron radiation and of high temperatures appear as special problems under nuclear power plant conditions. Only after a many-sided study of these effects were we able to correctly interpret the measurement data obtained in a power plant. In addition--in the interest of a more reliable determination of accidental doses--we developed a method for a re-evaluation of plant thermoluminescent dosimeters and for determining local beta/gamma doses. The PILLE portable dosimeter represented a special application of the results achieved in development of thermoluminescent dosimeters; we developed this originally for use in space ships. Bertalan Farkas was the first to use it at the Salyut-6 space station, then American astronauts made successful measurements with it

on the Challenger space shuttle. Considering its portable nature and wide measurement range it could also be used in accident situations.

We developed methods based on solid body tracer detection for neutron dosimetry; these provided reliable results even under nuclear power plant conditions.

In regard to internal radiation burden our research--in harmony with international efforts--was directed at determining the organ level burden. In the interest of this we further developed a whole body counter device and developed an evaluation method with the aid of which it is possible to determine in the most modern manner achievable today the internal dose burden of persons selected by the routine screening at the Paks nuclear power plant. We proved the utility of the method with studies of a few Paks power plant workers. Another method is available for sensitive determination of the Sr-90 content of urine and for checking tritium incorporation.

#### Radiation Decontamination

We developed effective, fast procedures for decontamination of surfaces contaminated with radioactive materials in which a minimum quantity of radioactive waste water is produced. We created laboratory equipment operating constantly under high pressure, high temperature, dynamic conditions to produce the metal samples necessary for research. We systematically studied the various decontamination receptacles. We developed and handed over for power plant use an electrolytic decontamination procedure and equipment with manual and automatically moving cathodes.

#### Environmental Control

At the end of the 1970's, as part of the nuclear power plant investment, we built a remote measuring system which continuously checks the release of radioactive materials, the meteorological data needed to calculate atmospheric spread and--using stations located in the environs--the radiation situation. The system has been operating reliably--with the exception of crude effects--since September 1982 (thus since the first block was put into operation). We studied the effect on quantities measured of the fluctuation of the contribution from the natural radioactivity of the environment. On the basis of this we worked out a correlation method to reduce the indication limit. We established on the basis of a computer processing of the data that the system is suitable for checking adherence to the normal operation official dose limits and is capable of providing useful data to evaluate the environmental effect of a possible accident. With the remote measuring system we did not detect an environmental dose burden or radioactive contamination coming from the power plant--which is in harmony with the extraordinarily small atmospheric and water release. In the interest of maintaining this favorable situation we automated the checking of the effectiveness of the aerosol air filters built into the ventilating system of the power plant and developed a mobile measuring system.

We put together both installed and portable measuring systems for sensitive measurement of environmental samples and for measuring in-situ environmental

radiation and we developed computer methods to evaluate the measurement data. We proved the reliability of the new measurement equipment and evaluation methods in domestic and international tests.

We studied the environmental effects to be expected from accidental releases with the aid of atmospheric spread models. The environmental radiation burden caused by both short and long term releases can be determined with the computer programs developed. The results of the calculations performed aided in laying foundations for the Accident Prevention Measures Plan (BEIT) and had a significant role in the application of accident prevention practices.

We developed a method to measure the tritium concentration of annual rings of trees; in the event of a suspected uncheckable release this is suitable for a retrospective check of environmental tritium contamination. We also solved measurement of the tritium concentration in various waters and atmospheres of the nuclear power plant, which provides useful information regarding operational status (e.g., leakage).

We constantly measured the total beta activity appearing in the fallout of fission products coming from atmospheric nuclear weapons tests. This measurement has been done continuously since 1952 and has produced a data series unique in the world. The annual sums of beta activity hardly changed between 1981 and 1985, if we disregard the fact that we found an approximate threefold increase in activity in 1981 as a result of the atmospheric thermonuclear explosion in China in October 1980.

As we have seen the existence and further construction tasks of the Paks nuclear power plant determined the direction, frameworks and content of nuclear energy research taking place in the MTA institutes between 1981 and 1985. The institutes continue to regard the development of the scientific background for domestic nuclear energetics as their task. In the interest of this they are striving to make ever more modern tools and methods available to the operating experts.

Nuclear energetics is typically a "peak technology." It shows this in all its aspects--it requires gigantic sums, but it is also capable of paying back the investment; the greatest part of the know-how is concentrated in the hands of powerful world firms, at the same time, wherever it is used it presumes great technical preparation. The introduction and continual use of such a technology is extraordinarily research intensive. We hope that the above provides sufficiently convincing arguments in this regard. In the case of a country the size of Hungary a collateral problem arises, that without regard to the material possibilities we expect from ourselves the same level of safety as the most developed countries. There can be no question of our producing all the necessary know-how by ourselves, so active participation in such international efforts is indispensable. The safety problems connected with nuclear energetics indicate unambiguously that there is a need for a scientific background which cooperates closely with operations but is independent from it in regard to material interest. No room must be given to the idea--at first sight plausible--which would want to operate and maintain the nuclear energetics research base solely with economic tools.



[The accompanying table shows the development of the R and D costs of the Academy research institutes according to financing modes and sources. The vertical scale is in millions of forints at current prices. The categories, from top to bottom, appear below.]

#### Task Financing

centralized technical development fund

state budget

from R and D institutes

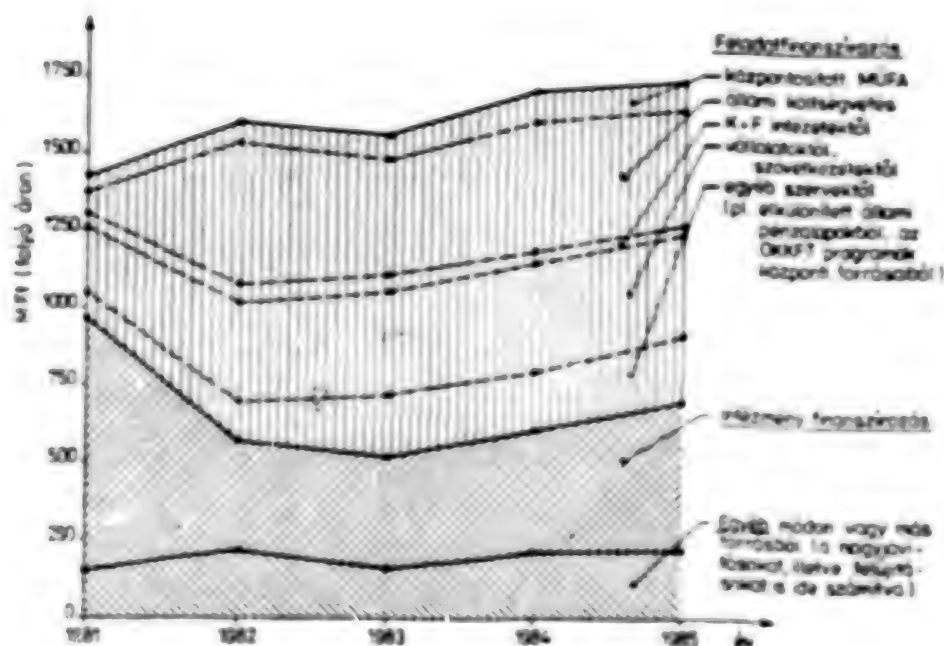
from enterprises and cooperatives

from other organs

(e.g., segregated state funds, central resources of OKKFT program)

#### Institution Financing

Other Modes or Other Sources (including major repairs and renovation)



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CSO: 2502/61



## HUNGARIAN ACADEMY ACHIEVEMENTS IN SOLIDS RESEARCH

Budapest MAGYAR TUDOMANY in Hungarian No 4, Apr 87 pp 292-300

[Article by Emil Kren, candidate in physical sciences, deputy director in chief of the Central Physics Research Institute of the MTA (Hungarian Academy of Sciences), and Tivadar Siklos, doctor of physical sciences, department chief in the Central Physics Research Institute of the MTA: "Thoughts About More Recent Achievements in Domestic Solid Body Research"]

[Excerpts] Without good quality materials and parts our products cannot be modern, and we cannot rely only on import from developed countries to acquire them. We also must produce outstanding quality materials and parts, if not in every area. The guarantee of this is solid body research and a consistent utilization of the achievements of basic research in the materials sciences.

The Hungarian Academy of Sciences has turned great attention to questions connected with the development of solid body research for many years. Thanks to this a knowledgeable, enthusiastic research staff, which has won international recognition in many cases, works in the institutes of the MTA in the area of solid body research.

We must note with sorrow, however, that the conditions for scientific research work have significantly deteriorated in recent years. In the period under study research costs have risen significantly as a result of price increases while budgetary support has stagnated; the increasing but strongly taxed sales receipts of the research institutes have not been able to compensate for the cost increases—including the strong increase in overhead costs. The planned low level of investment possibilities and the significant decrease even in these has led to an ageing of the research tools inventory.

We are convinced that despite the deteriorating research conditions "solid bodies research" has met the chief research expectations at the national level. This is thanks to the preparedness and ingenuity of the research staff, but at the same time we must see clearly that the available reserves have already been completely exhausted.

Some of the achievements of research done within the framework of the chief trend are basic research achievements highly valued even by international scientific public opinion. Other achievements have been used in industry,

bringing considerable profit to the national economy. At the same time we must note with sorrow that we have a large number of achievements which have not yet been exploited by the national economy.

It is impossible to describe within a brief study all the results of solid body research on so many themes, done in a coordinated way in cooperation with universities and a number of industrial enterprises, especially to do so in a way to make the results more or less understandable outside narrower professional circles. Therefore--accepting the charge of subjectivity--we decided to give only a taste of the results achieved in the several research areas and not to try to be complete. So, for example, we will not talk about the significant activity in developing research tools, activity which has been so successful in recent years in the area of solid body research. We have devoted more significant room to describing results achieved in the area of research on partly ordered and disordered materials, because these have come into the center of interest in recent years. It is gratifying that Hungarian researchers entered this new research field in good time and can lay claim to a number of achievements recognized as significant even internationally. Then we will speak briefly of a few outstanding results achieved in the area of crystal physics, semiconductor and thin layer research.

#### Research on Partly Ordered and Disordered Materials and Nonlinear Phenomena

Hungarian researchers recognized in time new tendencies appearing in international research trends and, with the existing research experience, were well able to turn this recognition to account. In the course of recent years they achieved a number of results in these research areas--along both experimental and theoretical lines--which are very highly valued by both domestic and international scientific public opinion. We want to illustrate these achievements with a few arbitrarily chosen examples.

Of the domestic experimental achievements we would like to stress the conditions for developing a localized electron system in near one-dimensional organic charge transmitting salts, the manifestations of disorder in electric transport properties, and the domestic measurements experimentally disclosing or confirming the effect on electron structure of local lattice faults in organic and inorganic chain structure materials of various base states. The fruitfulness of our research in these areas is proven not only by the large number of publications which have appeared in prestigious international journals and by the very large number of citations to them but also, among other things, by the fact that the first international scientific conference on quasi-one-dimensional organic materials was held in our country in 1976 and the first such conference on charge density waves was held in our country in 1984, conferences which were attended by all leading researchers in the area from every part of the world.

It is an everyday experience that as temperature changes materials go from a solid phase to a liquid phase. But there are organic materials made up of stick shaped or disk shaped molecules for which this phase transition is not so simple; several intermediate, so-called mesomorphic phases appear between the solid and liquid phase. In the case of materials made up of molecules which are not spherically symmetrical a number of ordering processes can

arise. For example, a three-dimensional order of mass centers may remain, but orientation could be disordered, for example rotation around some axis or, on the contrary, the three-dimensional order of the mass centers may cease, but their orientation order remains to a certain degree. Materials with this interesting property, which we call liquid crystals, are already used industrially in large quantities, for example in various display devices, but their pharmaceutical application is significant also. At the same time, much remains to be done in the area of discovering and explaining their properties.

Our researchers have observed a number of new phenomena in the area of liquid crystal research, they have found various instabilities, they have observed the development of new, previously unknown phases from a glass state achieved with fast cooling, and they have studied these structures with neutron and X ray diffraction, seeking a link between the structure and the properties. They have shown that the liquid crystal molecules can be reoriented with the electric field of laser light; this meant the first description of a new non-linear optical phenomenon.

One of the important questions in the physics of disordered systems relates to the concept of percolation, which proved very suitable for a description of the geometric transformations taking place in many sorts of disordered systems.

There are two constituents (A and B) in the simplest percolation model; placed randomly at the points of a regular lattice these produce the disorder. If we constantly increase the proportion of the A constituent from a small value then the clusters defined by neighboring constituents of the same type, at first small, gradually grow and at some threshold concentration some of them merge into one cluster extending to the entire lattice; a sort of order--or a new phase--comes into being in the system. We call this purely geometric transformation a percolation transition. It has been proven that the percolation transition is a close analogy to a type of thermodynamic phase transition.

There are two important consequences, among others, of the similarity between percolation and thermodynamic phase transformations. On the one hand a study of the substantially simpler percolation models aids an understanding of phase transformations taking place in interacting systems, on the other hand it creates an opportunity, in the course of studying the percolation transition, for using efficient methods worked out in the past decade to describe critical phenomena. The percolation theory also has great significance from the practical viewpoint because it can be used to discover deeper interdependencies hiding in the production technology for a number of inhomogeneous structure materials. For example, a number of percolation phenomena take place in the course of the powder metallurgy process; this includes the gradual merging of the particles into a solid material, the vaporization (filtering) of additive materials among the particles, etc. And the percolation image can also be used well to explain the gelling process and certain unusual properties of water.

Using Monte Carlo simulation--the first time in the world that this method was used to solve percolation problems--and the renormalization group method

Hungarian researchers calculated the critical points and indexes of various percolation systems. Using numeric and analytic methods they studied the diffusion taking place in percolation clusters and proved or established interdependencies between the static and dynamic percolation quantities. With the aid of simulation they produced and proved the scale properties of cluster distribution in a model of aggregation.

Nonlinear phenomena play a fundamental role in a number of branches of science today and it could be said that in recent times there has been a breakthrough development in the understanding of them. One spectacular manifestation of this is that extraordinarily complex, irregular forms of movement can develop even in relatively simple nonlinear systems, movements which can be interpreted as stochastic solutions of deterministic equations. Such so-called chaotic movement--for the description of which we must use statistical methods--has come to the forefront of interest in various areas of the basic and applied sciences. Joining in this upsurging research in statu nascendi we in our country achieved significant results in the theoretical definition of the properties of a completely developed chaotic state, we generalized the dynamic scale hypothesis and renormalization group procedure for the case of transition into a limit cycle, we studied the effect of fluctuations in the limit cycle state, and we showed that in the presence of these the character of the transition into phase chaos fundamentally changes.

Research on nonlinear phenomena also includes a study of the interaction of matter and intensive laser light, within the framework of which Hungarian researchers worked out a theory of nonlinear scatter processes for charged particles taking place in an intensive radiation space.

#### Crystal Physics Research

At the same time, from the viewpoint of solid body research, fundamental significance continues to attach to the production of solid bodies which are extraordinarily pure, or have been deliberately doped in a way which can be followed, which have a precisely defined structure in regard to geometric makeup, or deviate from it in a well defined way, that is to the production of crystals and a study of their physical properties, including a demonstration and interpretation of the effects of impurities or deviations from the ideal order.

Crystal physics research has significant domestic traditions. The still valid theory of the properties of crystals is called the Born-Karman theory. Max Born and Imre Brody further developed this basically correct theoretical model in the 1920's, taking into consideration, with the method of perturbation calculation, the interactions of the small amplitude vibrations around the balanced state of the crystal lattice atoms, we call these phonons. This new idea started the Born-Karman theory of the dynamics of crystals on a truly victorious path. Only most recent studies have shown that although the amplitudes of the vibrations are still small in the vicinity of the  $T_m$  melting point at temperatures one third to one half higher than the  $T_m$  melting temperature the method of perturbation calculation can no longer be used for a description of the properties of a crystal but rather one must take into consideration the interactions of the lattice vibrations in a self-consistent



manner. The self-consistent phonon theory, in the development of which Hungarian researchers participated almost as a tradition, successfully describes the properties of crystals up to near the melting point and leads to the instability of the crystal state at a given temperature.

Research on crystal growth began in our country almost at the same time as in the most developed industrial countries. In 1950-1951, at the same time as the Bell Laboratories in the United States, we achieved the first results in the area of producing artificial piezoelectric quartz monocrystals. Since then the manufacture of artificial quartz crystals has developed to a significant degree abroad while our own achievements have sunk into oblivion. Although the natural quartz reserves of the world are being exhausted use of them is growing ever more quickly in the communications engineering and optical industry. Unfortunately it is not characteristic of the domestic situation but the manufacture of sodium iodide monocrystals activated with thallium, suitable for detecting nuclear radiations, was undertaken at the GAMMA factory, the factory substantially further developed the procedure handed over, and today the Gamma detectors are among the products of the enterprise sought after around the world.

During the last 5-year plan our researchers developed production, purification and growth technologies for a number of primary materials for the production of various high purity or doped monocrystals using primary materials obtainable here and they developed working procedures of suitable optical quality. An especially significant achievement is the continuous or quasi-continuous growth method for improving the quality and yield of various garnet monocrystals (e.g., GGG--gallium-gadolinium-garnet) which can be grown with the Czochralski method; in this method an automatic diameter regulator ensures the stability and thus the freedom from faults of the crystal diameter.

A study of the physical and optical properties of grown crystals led in part to new scientific discoveries and also made possible a further development of the growth procedures.

Domestic device development institutions need the achievements of crystal physics research. Thus the SZTAKI [Computer Technology and Automation Research Institute] and the Physics Institute of the BME [Budapest Technical University] developed acousto-optical laser elements out of tellurium dioxide monocrystals. Using these laser elements they developed various noncontact measurement technology devices and made them available to industry (e.g., a tungsten filament thickness meter for Tunsgam, a paper roughness meter for the Paper Industry Enterprise, etc.). The Microelectronics Enterprise uses lithium niobate monocrystals in the manufacture of AFH (acoustic surface wave) filters used in television sets. Medicor used zinc tungstate crystals in the development of a computerized tomograph. Domestic research and cooperating international research needs specially doped alkali halogen and garnet monocrystals.

Reviewing the achievements of the past 5 years we can say that there has been significant progress in the area of crystal physics research in our country despite the fact that the tools available for research and development, especially in the Crystal Physics Research Laboratory, are extraordinarily



obsolete; not infrequently they were forced to use equipment of museum value. In part this makes it understandable that we can characterize much of the research and development work as a following activity. But the significance of insulating monocrystals is well indicated by the fact that today, around the world, they are producing 3,000 tons of semiconductor monocrystals and 1,000 tons of insulating monocrystals annually.

As a result of the still considerable insensitivity of our industry to continual development and renewal of the product structure and to market orientation and of the inadequate interest system for research and manufacture a monocrystal manufacturing industry, promising significant profit and good markets, has not developed in our country and this is also a serious obstacle to the development of a number of industrial areas.

It seems proper to recall here the memory research done in the last decade with significant material and intellectual forces, because it was bubble memory research that justified the development of the growth of the GGG crystals mentioned above. Within the framework of this bubble memory prototypes were produced and it was possible to demonstrate their operability.

#### Semiconductor and Thin Layer Research

One characteristic chapter in the stormy development of the microelectronics industry is the swift spread of gallium arsenide (GaAs) and related materials (the so-called III-V semiconductors). In the developed industrial countries in the past decade the GaAs devices have gone from research and laboratory development to industrial mass manufacture, and GaAs has become, after silicon, the most important semiconductor material. Hungarian gallium production gives special timeliness to domestic research; we sell it in the metal form--thus in the least economical way. Unfortunately a decision pertaining to converting to higher processing forms (e.g., GaAs monocrystals) has drag on for years.

We must regard it as arousing hope that the most significant results achieved in our country in the area of semiconductor research have been in connection with gallium compounds. Our researchers were the first in the world to produce pseudo-ternary antimonides in the form of a homogenous phase and new semiconductor materials (GaPAsSb and AlGaInSb) the forbidden band of which covers the optical range most important for selective spectroscopy (0.6-5.0 microns).

Our researchers developed a production technology and the necessary equipment for the materials mentioned, in the process observing a new physical phenomenon (selective epitaxis) in crystal growth. By studying the physical properties of the new solid phases they established that GaPAsSb is an outstanding luminescent material and so can be used as a selective light source while AlGaInSb can be used as a detector (e.g., in place of germanium). Hungarian researchers also succeeded in making heterosystems containing 5-100 thin layers--so-called super lattices--out of these materials. The leading foreign research sites produce super lattices by using peak technologies (e.g., molecule radiation epitaxis and metal alkyl decomposition) while in our country they succeeded in developing a cheaper and fast new method. The

significance of the domestic success is indicated by the fact that the thickness of each thin layer is comparable to the free path length of the charge carriers.

Technological procedures were developed in our country for the production of bulk InAs and GaSb and from these our researchers produced narrow band infrared detectors and magnetic sensors. For example, using InAs they developed magnetic sensors twice as sensitive as the similar Siemens type and they made movement detectors which have proven out well in the Matravidek Coal Mines.

An outstanding achievement in connection with thin layer research was the development of a thin layer technology based on chemical separation for the production of PbS, PbSb and  $\text{PbS}_x\text{Se}_{1-x}$  thin layers. Using these they developed broad band, highly sensitive infrared detector types and organized small series production of them. The PbS detector developed in the course of research is equivalent to corresponding Japanese and US products; for example, the Labor-MIM [Laboratory Instrument Industry Works] can use them to replace American detectors in the equipment being manufactured on the basis of a US license (INFRARAPID). These detectors have also been used in strand temperature measuring equipment made for wire drawing.

We can report achievements highly valued even internationally in the area of thin layer research done with ultra high vacuum (UHV) in situ transmission electron microscopy (TEM). They developed a comprehensive model to explain the atomic structure of layers as multicomponent systems which interprets the possible role of foreign atoms (contaminants, additives) in various phases of layer formation. They studied the effect of solid phase contaminants on the surface of monocrystal carriers on the growth of the epitaxial layer. On the basis of their results they developed a new decoration method for a morphological analysis of the initial phase of surface chemical interactions. The new results contributed, even internationally, to making the picture about layer formation processes more complete. They gave an interpretation of a number of structural-morphological phenomena appearing in practice and often causing defects in devices. We should note that the UHV in situ TEM experimental study method is unique in the world. The results pertaining to layer formation processes and surface chemical interactions directed the attention of international research as well to the determining role of contamination limits.

We have outlined above a few of the outstanding results achieved in the past 5 years in the area of solid body research in the research institutes of the MTA. [Footnote: These are: The Central Physics Research Institute (and the Solid Body Physics Research Institute, the Microelectronics Research Institute and the Particle and Nuclear Physics Research Institute therein), the Technical Physics Research Institute, the Natural Sciences Research Laboratory (and the Crystal Physics Research Laboratory and the Biophysics Research Laboratory therein), the Isotope Institute, the Nuclear Research Institute and a few Academy research groups working in the universities.] But successful solid body research also took place at a number of university faculties and within the framework of a few industrial enterprises. The various guiding organs for national solid body research (the Solid Body

Research Complex Committee and Coordinating Council) organized and coordinated this ramified activity. We are convinced that the careful surveys and analytical activity, coordinating the operation of various domestic shops, eliminating superfluous parallelism, etc., performed by the above mentioned guiding organs contributed to these successes. We sincerely hope that in the future the interministry program for Materials Science Basic Research, now being organized, will provide a working framework for solid body research, of such great significance from the viewpoint of both science and the national economy, in a similarly effective manner.

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CSO: 2502/61

## HUNGARIAN ACADEMY RESEARCH IN ELECTRONICS

Budapest MAGYAR TUDOMANY in Hungarian No 4, Apr 87 pp 310-318

[Article by Peter Bakonyi, candidate in technical sciences, deputy director of the MTA SZTAKI (Computer Technology and Automation Research Institute of the Hungarian Academy of Sciences): "Achievements of Electronics Research at the Academy"]

[Text] From this article we can become acquainted with two aspects of electronics research done at Academy research sites. One is characterized by tools and methods serving the most varied disciplines--the social sciences, biology, nuclear technology. The hardware and software tools created in the course of applications can be transported to other research areas too. The other trend also showing significant achievements is the practical and theoretical research work needed to create the device background for computer science and technology.

He undertakes a difficult task who tries to sum up the results achieved by Academy research sites in the area of electronics research during the previous plan cycle.

The theme area outlined in the title is very broad, including the chief trends of computer technology, automation and communications research. In the present article we will place the emphasis primarily on those achievements of computer technology and automation research which have produced for a number of scientific areas research conditions suiting the level of the age. Going beyond this we will also stress those achievements which show the economic benefit of research in this area, which might make a significant contribution to the national programs of the Seventh 5-Year Plan because of their forward looking character or which have elicited a serious international response.

Because of the comprehensive and ramified nature of the theme area the goal cannot be to strive for completeness. Instead the article strives primarily to describe the achievements of the "Computer Technology Applications Research" program of the Sixth 5-Year Plan of the Hungarian Academy of Sciences. For this reason our compilation deals especially with the application of the research achievements of computer technology in the social sciences, medical biology and nuclear measurement technology. The industrial applications of electronics research (computer aided design and manufacture, robotics, remote

data processing and process control) and a description of the research results eliciting a serious response even internationally (image and signal processing, artificial intelligence) also receive an important place.

Finally we review the results of the research dealing with theoretical and practical questions of the device background for this area. Among the theoretical questions we discuss problems of database management, networks and theoretical computer science. Serious results have been achieved in practical R and D activity in the areas of computer systems, networks and measurement automation systems. A description of this is also justified because it has produced devices and systems falling under the embargo, in the sphere of so-called peak technology.

#### Research Achievements

##### Social Science Applications

The Sociology Research Institute of the MTA and MTA SZTAKI have developed systems supporting social science computations. Since 1981 colleagues of the two institutes have continuously implemented on various computers elements of the "multidimensional scaling" (MDS) program package. The mathematical methods used and their computer technology realization have been described in publications titled "Modszertani Füzetek" [Methodological Pamphlets]. The other significant social science program package is SZOCPROG, which has been constantly expanded for years (cross-table analysis, MDS programs, partial and semipartial correlation, etc.).

The archive of social science research data files can be regarded as an especially forward looking achievement; it was developed with the joint work of the Sociology Research Institute, the Historical Sciences Institute and the SZTAKI of the MTA. Creation of the data archive was justified by the fact that the significant resources turned to assembling and preparing the data for large social science studies can be utilized better if the data are also accessible for other, later research. Lacking domestic antecedents it was first necessary to conduct methodological work to make discoveries and lay the foundations. Acquiring experience began by developing several data files coming primarily from a processing of historical sources. The need for computer archiving and processing of large social science databases increased to such a degree in recent years that it became necessary to create the Social Research Informatics Society (TARKI) which already represents a suitable base for further successful work.

##### Biology and Life Science Applications

The use of computer technology procedures (data processing and simulation) when modeling the structure and operation of neurons and neuron nets for work done at the Anatomy Institute of the SOTE [Semmelweis Medical Science University] meant a new approach in the quantitative analysis of the elemental working units (neurons) of the central nervous system. In the course of this work they created, for example, the "Neuron" program reconstructing three-dimensional structures from optical microscope histological sections on the basis of the so-called stick model. With the aid of this it is possible to



determine the relative spatial position of nerve cells hindering and stimulating the visual system centers (visual cortex and subcortex). Going beyond this they also developed a microprocessor, intelligent peripheral controlling an optical microscope suitable for putting morphological data into a computer.

The MTA KKKI [Central Chemical Research Institute of the Hungarian Academy of Sciences], the II Pathological Anatomy Institute of the SOTE and the Computer Center of the Munster University cooperated in achieving results in modeling the dynamics of cell membrane receptors; the importance of this lies in the fact that with the aid of the model one can create a picture of the microscopic phenomena providing a background for empirical phenomena. This makes possible a better understanding of the mechanisms and a more substantive interpretation of the phenomenological picture. Research done with the aid of computer technology meant a valuable contribution to the analysis of cell membrane sensing systems (receptors), the molecules mediating information for the sensing system (the ligands) and thus the molecular signals reaching the cells.

The Urology Clinic of the SOTE developed a system to collect and process measurement data which serves computerized research in endogenous peptides. Studying the structure and function of the peptides and genes regulating the internal functioning of cells came into the center of biological research in the 1980's. The Clinical Biochemistry and Cell Biology Division of the MTA-SOTE EKSZ had as its goal research on peptides regulating cell division in an endogenous manner and peptides appearing in the course of pathological processes. Recognizing the peptides which have a very great effect could give a key to recognizing cell division processes of fundamental importance and could contribute to warding off toxic conditions arising as a concomitant of certain pathological processes.

A significant part of the basic instrument inventory supporting research was available to the base laboratory, but computerized methods are indispensable for efficient and fast processing of the measurement data provided by these instruments. The biological measurement data collecting system makes possible fast evaluation of the treatment with effective materials (peptides) given to populations consisting of several million cells.

The Psychological Institute of the MTA developed a computerized psychophysiological laboratory system which is a computerized system for processing measurement data obtained with analog signals. (Such a complete system and software cannot be obtained on the socialist market.) At the institute they created--relying primarily on domestic hardware devices--a modern information processing system for psychophysiological research based on a TPA-1140 computer and they developed an off-line analog signal processing program system which is competitive even at the international level. The signal processing programs prepared thus far serve primarily an analysis of induced brain potentials. An analysis from various viewpoints and a comparison using statistical methods of large volumes of responses recorded in behavioral experiments is done in the interactive mode. The researchers have described their results in significant international journals and at scientific meetings; the programs prepared are constantly used to process experimental

data of psychophysiological laboratories and have also been used in Intercosmos research.

The BME-HEI [Communications Engineering Electronics Institute of the Budapest Technical University] has studied problems of processing signals changing in time. One valuable applications example of this research is a microcomputer EKG mass screening system which operates at the Pulmonary Screening Station in Godollo.

#### Nuclear Measurement Technology

The KFKI [Central Physics Research Institute] has developed computerized systems and methods for monitoring and automatically controlling the operational parameters of particle accelerating equipment. The task of the NIK accelerator operating at the KFKI is to insert to a definite depth definite quantities of definite materials in even concentrations into test bodies, primarily for semiconductor physics studies but also for solid body physics and plasma physics studies. Implantation is today a very important part of the manufacturing technology for semiconductor devices. A study of the physical foundations of implantation contributes to the clarification of a number of still unsolved questions.

The computerized controls being built will make possible or will aid adherence to the strict quality and reproducibility requirements arising during implantation. Semiconductor physics, solid body physics and plasma physics will use the results.

Also at the KFKI they did research on developing computerized systems and methods for automatic processing of track chamber (e.g., bubble chamber) photographs. The development of a track chamber photograph measuring system has reached the point where it can be used in physical measurements. The precision of the measurement is substantially better than that of earlier manual measurements. The equipment has been tried out abroad as well; one test was done at the CERN, jointly with a number of Western European countries in an international high energy physics experiment; another was done within the framework of cooperation organized by the United Nuclear Research Institute at Dubna. On the basis of the results attained they accepted Hungary as a partner in measurements to be done on the world's largest accelerator, measurements belonging in the world forefront, without Hungary having to undertake a part of the astronomical costs of building the accelerator and experimental equipment.

Adaptation of a part of the measurement system for the new, high acceleration measurement has begun.

At the Isotope Institute and ATOMKI [Nuclear Research Institute] they worked out computerized methods for collection and processing of data from nuclear measurement layouts. A solution of an important industrial control technology task was born as a result of work being done at the Isotope Institute. With the aid of the solution it would be possible to do continual, non-destructive material testing, for example during ore processing. Despite the great benefit to be expected there has not yet been an economic exploitation of the result

due to the situation of the branch of industry (postponing the opening of the Recsek mine). An operational laboratory version of the instrument is being prepared.

At ATOMKI they have prepared programs to evaluate photo electron and X ray spectra, to evaluate both individual and series measurements. The methods are suitable for chemical analysis and have already been used for medical, biological, atmospheric pollution and industrial measurements.

#### Industrial Applications

One of the central research themes for SZTAKI is research on computer aided design and manufacturing systems (CAD/CAM) needed for machine industry automation. Work has been done in three chief areas:

- control of manufacturing systems,
- machine tool supervision, and
- development of concrete computerized designing and manufacturing systems.

In the course of the work they made--among other things--a distributed, general purpose industrial control system. The surface designing system (FFS--Free-Form Shapes) is used in domestic plants and abroad. From the composing of such surfaces one can design very complicated parts and tools which can also be manufactured on the basis of data stored in the computer. They are worked automatically by numerically controlled machine tools. A new robot simulation system has been prepared at SZTAKI as well.

Our domestic factories--IKARUS, SZIM [Machine Tool Industry Works], CsMSzG [Machine Tool Factory of the Csepel Works], Ganz-Mavag, VILATI--are using with success the methods and equipment developed.

Also at SZTAKI they did work of outstanding significance in research on computer aided methods and tools for electronic designing. The complexity and speed of electronic circuits and systems are on such a scale today that one cannot use traditional methods in the technology of design, manufacture and control. In the course of studying the problems it turned out that new principles had to be introduced which were suitable for mechanization of the designing and manufacturing processes even in the event of an increase in the complexity of parts and subsystems. For example, the role of fixed principle designs increased and the method of designing simultaneously at several levels came to the fore. A concrete application system has not been completed yet but the experiments are reassuring.

Also worthy of mention is the general robot research done at SZTAKI. Its purpose--among other things--is creation of a movement simulation system to develop programming tools for assembly work which can be done with robots, development of a motion planning program system and integration of programming and sensing in robot control.

Within the framework of object and texture recognition the SZTAKI has dealt fundamentally with two questions--the development of an industrial form recognition unit and the creation of new digital texture analysis methods (the

first theme is a developmental one, the second has more of a scientific research character). The industrial image recognition system is a microprocessor system supplied with camera and image digitizer which is capable of processing and interpreting virtual information, for example, of recognizing parts. The system is being made primarily to work with robots and jiggling feeders.

In the digital texture analysis theme area texture is a nonfigurative image which contains statistically repeating, regular or random samples (e.g., images depicting the surface of various materials). The result of the work is a number of new texture analysis methods which have been used in texture study program packages.

The theoretical and practical work done at MTA SZTAKI in connection with nuclear power plant manipulators has outstanding applications technology significance, because very high reliability and availability requirements are made of equipment used in nuclear power plants. On the basis of theoretical studies they developed a control system and drive regulators for fuel element reloading machines for 440 MW and 1,000 MW nuclear reactors. The EVIG [United Electrical Machine Factory] is manufacturing the equipment and it is operating in the nuclear power plants of the socialist countries (at the Paks Nuclear Power Plant among others).

They developed at the SZTAKI intelligent process control equipment called the Intellicon which controls production processes and is suitable for simultaneous handling of complex regulation, control and periodic guidance tasks. A number of producing plants already use the equipment, such as the Sarkad Sugar Factory, the Romhányi Tile Factory, the Thermal Power Plants, etc.

An important element of computer networks is the remote data processing front-end processor (TAF processor) which was developed at the SZTAKI. The TAF processor is suitable for controlling data transmission between ESZR [Uniform Computer Technology System] computers and their terminals. The TAF processor can be connected to several computers simultaneously. It can connect these with the terminals, also connected to it, for the desired time. The telephone factory manufactures the equipment in series already.

#### Image and Signal Processing, Artificial Intelligence

The research done at the MTA KFKI on handling, coding and processing images brought great success even internationally. An earlier developed image processing system constituted the basis for the activity. The results in connection with this made it possible for our country, and the KFKI therein, to be invited to participate in the VEGA project being conducted with broad international cooperation and aimed at observing Halley's Comet which passed near the sun in March 1986. The significance of the project is already well known to everybody.

Within the framework of the VEGA program two--interdependent--tasks had to be solved.



1. It was necessary to make on-board automatic television equipment capable of transmitting to Earth pictures, with radiometric precision, of the comet nucleus flashing past near the probe. The system contained two telescopes, exchangeable color filters and four high resolution image detectors. In addition to transmitting image information in suitable form the dual microprocessor based system provided control signals to the platform, which could turn around two axes, in order to track the comet nucleus; in addition to the camera the platform also held the other direction sensitive instruments of the satellite. Development of the system which operated under extreme conditions, had the prescribed weight and consumption parameters and at the same time met extraordinarily great reliability requirements required the solution of a number of new tasks in regard to hardware architecture, software and mechanical design.

2. The earth control equipment for the on-board system is based on an image processing system. With its aid the flying system can be tested, checked and calibrated. This control system makes possible complete functional monitoring and restoration and display of data arriving via telemetry, and provided a simulation of platform and comet in connection with alignment and with its aid one could check the correctness of the program system.

Research in the area of methods and practical application of artificial intelligence and expert systems has been done at the SZTAKI. Artificial intelligence research has been done at the institute for a long time; initially they studied object and form recognition systems. The results have been used in development of control systems for robots which can be used to check industrial objects. The newer phase of research has been directed at development of expert systems. Within this framework, in cooperation with the neurohabilitation department of the Szabadsag Mountain Children's Clinic, they developed a system which serves early diagnosis and therapy of nervous system injuries at the time of birth. The system aids primarily developmental and medical research. An interesting feature is that the system includes a voice input unit with 20-30 command words; thanks to this it is possible for a physician with his hands occupied to communicate with the computerized system.

In the meantime they have completed preparations to develop a new type of expert system. This is a public administration expert system which will be used first at small town councils.

#### Device Background: Theoretical and Practical Solutions

##### Theoretical Solutions

Outstanding in the area of theoretical research is the work of the BME-HEI on development of tools for description, simulation and verification of hardware, firmware and software. In the course of this they prepared a description method suitable for theoretical studies of hardware and firmware systems. The work done constitutes a part of the domestic tasks undertaken in the plans for ESZR Scientific Research Work.

The use of database management methods in system building technology has been studied at the MTA SZTAKI. Originally the goal was development of conceptual



modeling and description methods and creation of a computerized system supporting these. Later they took up use under industrial conditions of the methods and tools developed. The goals were met. The planned computerized system has been realized on various computers. The methods developed and the computerized system are used in Hungary (Volan Electronic, EMO [Elektromodul Electronic Parts Trading Enterprise], DV [Danube Iron Works] and INORGA) and abroad (UNIDO project).

The SZTAKI and KFKI have dealt with development of computer network models and algorithms the goal of which is:

- a study of the internal communication rules of networks, that is, protocols,
- development of a testing methodology for protocols, and
- active participation in international committees dealing with network protocols and the testing of them.

Results have appeared in the form of studies, publications, programs and know-how. The protocol testing procedures developed have been used even in a multinational bank network.

Research in the area of theoretical computer science has been done at the Mathematics Research Institute of the MTA. One central question of theory is delimiting the computational complexity of problem classes in various computation models. It is known that giving the lower estimates is especially difficult so it is a very valuable achievement that they succeeded in determining the precise lower estimate for the case of ordering done with parallel computation. Solving a problem which had been unsolved for years elicited a large international response.

In cooperation with the MTA SZTAKI they succeeded in proving inequalities among the various parameters of databases and there was an experiment on theoretical modeling of database changes.

In cooperation with the Microelectronics Enterprise they achieved new results in the mathematical problems necessary for layout of chips. These results will--hopefully--shorten the algorithm for layout design.

Finally we should mention achievements in the semantic branch of computer technology; these were developed in cooperation with the Tarsai group which created the semantic theory of mathematical logic. Important results were achieved in the area of programming logic within programming theory, for example in comparison of famous program verification methods. The achievements in connection with the decidability of relation calculuses are interesting also.

#### Practical Solutions

One of the most important research and development achievements of recent times from the viewpoint of practical utility was the development at the KFKI of a 32 bit architecture megamini. Preparations began in 1982 with creation of a system plan which defined the mechanical design, the parts base, adaptation of the several modules of the operating system and methods for testing and

calibration. A delay in certain investments was accompanied by a slipping of the program but they succeeded in completing the essential "laying the foundations" work. This meant primarily development of the operating system and high level programming languages and design and manufacture of large (300 x 400 mm) printed circuit cards, which counted as a pioneering activity in domestic practice at the time. The first processor unit was completed in 1984 and most of the cards of the computer were ready by 1985.

One of the greatest achievements of the development was a transformation of attitude. An expert staff of hardware and software developers and technologists was created which was experienced in development of new computer designs and was capable of grasping problems at the system level and of offering more than the quality demanded up to now. With its performance the computer will occupy a unique position in domestic computer technology.

In the sphere of practical research and development the SZTAKI has dealt with development of distributed systems based on a local net. The goal of the work is creation of research institute computer systems which, with the aid of modern computer technology devices (graphic displays, data transmission nets, etc.), will make possible automation of engineering design, research and management activities and the replacement of paper and pencil methods with interactive computerized methods. In the course of research and development they had to keep in mind the fact that the system being created should rely on domestic hardware and software tools already existing or under development, or that these tools should be available from socialist sources.

Within the framework of this work the MTA SZTAKI aimed at building a model network system with a heterogeneous base suitable for office automation purposes as well. By the end of 1985 there were prototypes for all the essential hardware, software and firmware components of the network. They then began operational testing of the secretary's station and of a network made up of secretary's stations. The network--which offers as services text editing, form and database management, use of management and calculation program packages and, as a network service, electronic mail--is open and is connected to the Academy computer network and thus to several large international networks as well.

The theme of distributed systems developed in a heterogeneous system environment, with which they have dealt at SZTAKI, also belongs in the sphere of computer networks. Taking into consideration the possibilities offered by the devices available under domestic circumstances a study of the peculiarities of distributed computer systems created in a heterogeneous system environment cannot be neglected by us. Publications have appeared concerning some details of the work; close cooperation on the theme developed with the Computer Center of the Scientific Academy of the GDR and with the corresponding work group of the Dresden Technical University.

As a continuation of its earlier work the KFKI has dealt with questions of automatic testing and automated measurement data processing (CAMAC). The KFKI developed new CAMAC modules, renovated several earlier types and continued CAMAC software development. The CAMAC modules developed are already being

manufactured and are used in a number of research instruments and in industrial installations to solve computerized measurement automation tasks.

Within the framework of future real-time system development they have prepared a system called EURO-86 and a programmable multichannel analyzer, the ICA80. The EURO-86 system has provided very useful experience for the development of a future real-time system; in its structure and realization it contains the fundamental characteristics developed thus far for the international standards being prepared for such systems. The set-up prepared can be used in the future as a multi-microprocessor real-time development system. The ICA80 programmable multichannel analyzer was made with exchangeable subassemblies. The first few models of the ICA80 are being used in various medical and nuclear laboratories.

Using newly prepared and already existing modules they succeeded in solving a number of concrete measurement automation tasks in the areas of physics research, chemical analytical measurement, medical biology and industrial process control. The largest system now under construction is a complex measurement automation system for a large fusion device (tokamak). It will use fourteen TPA 1148 computers, 51 subsystems and about 1,600 CAMAC modules and will be suitable for processing nearly 10,000 signals.

#### Conclusions

Significant results were achieved during the Sixth 5-Year Plan at the Academy research sites in the area of computer technology and automation research. The value of this statement is increased if we take into consideration the environmental conditions which made domestic development of this scientific area difficult.

Embargo measures in this area grew especially strict in this period and the possibilities for cooperation with the researchers of developed industrial countries deteriorated. In the past period, partly due to the embargo and partly because of the limited nature of investment possibilities, our backwardness compared to Western European countries grew significantly in the supply of computer technology tools. Despite these difficulties we maintained our position in international scientific life in the area of computer technology and automation research and we succeeded in winning new positions in some areas. Going beyond this we were able to provide Academy researchers with domestic solutions in place of the computer technology tools which could not be obtained, and did so on the basis of developmental achievements here at home.

It is difficult to single out a few of the very large number of different sort of achievements, and we did not undertake this. But we can say that modern trends of this scientific area can be found in domestic research, which is a very significant fact if we take into consideration that electronification is increasingly becoming a factor influencing the economic potential of a country.

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August 21, 1987

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